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THE THREE ELECTRIC LOCOMOTIVES of the Baltimore & Ohio R. R. tunnel line, at Baltimore, O., will soon be used to handle the passenger trains as well as the freight trains. The overhead conductors are being extended ¾ mile northward (to the new Mount Royal station) and 1,500 ft. southward, to obviate the necessity of using steam pusher engines on the tunnel approaches. The electric engines are giving good satisfaction, and the maximum trainload hauled so far has been a train of 41 loaded freight cars with two locomotives not working. The electric power plant is now being used not only to furnish the power for the tunnel locomotives but to run 180 street cars of the Baltimore Traction Co., and also to light the Camden station and yards, the tunnel, the Locust Point freightsheds, warehouses and yards, the Mount Clare shops and the new Mount Royal passenger station.

THE CASCADES LOCK, built by the U. S. government for passing the Cascades on the Columbia River, Oregon, was formally opened to traffic on Nov. 6. The completion of the 3,000 ft. of canal through the rocky gorge of the Columbia River and the construction of this lock was contracted for on Jan. 24, 1893, with J. G. & I. N. Day. It was to be finished in one year from the date of contract, but the unprecedented flood of June, 1894, and other causes delayed the work. The lock is 521 ft. long between hollow quoins, 90 ft. wide and has a low-water lift of 24 ft. The lock and guard gates are built of steel and were furnished by the Maryland Steel Company, of Sparrow's Point, Md. They are of the single-skin type, swinging freely on the pivots without the aid of rollers or flotation chambers. The height of the lower guard gate is 36 ft. above the miter-sill, and the lower lock gate is 46 ft. and the upper lock gate 40 ft. high, with an upper guard gate 54 ft. high. These are claimed to be the highest metal gates ever built; the five gates in the Sault Ste. Marie Canal, built by the U. S. government, ranging from 25½ to 43 ft. in height.

THE DRY-DOCK AT ABERDEEN, Scotland, has become famous among engineers for the deterioration of the Portland cement concrete used in its construction through the chemical action of the sea water. In 1887, repairs were carried out on the dock under the direction of Mr. P. J. Messent, M. Inst. C. E., but the deterioration has continued, so that the engineer to the Aberdeen Harbor Board has just made a report advising the entire reconstruction of the dock at an estimated cost of about $500,000. The action of the sea water on the cement at the Aberdeen dock was fully described in Proc. Inst. C. E., Vol. CVII, pp. 73-198.

ADDITIONAL WOOD PAVEMENTS IN MILWAUKEE are prohibited by an ordinance now pending before the common council of that city. The ordinance also provides that all pavements must be laid on concrete foundations. The ordinance may be amended to permit the use of wood pavements in outlying districts, to be laid on concrete. The requiring of concrete foundations would in itself practically exclude wood, according to Mr. Geo. H. Benzenberg, M. Am. Soc. C. E., City Engineer, who states that in Milwaukee brick pavement is cheaper than wood, if each is laid on concrete.

THE PROTECTION OF MACADAMIZED ROADS is aimed at in an ordinance prepared by the Street and Water Board of Jersey City, N. J. The trucking traffic on some of the avenues has become very heavy since the new pavement was put down, and much damage has already been done. The ordinance provides that vehicles which weigh, with their loads, 2,000 lbs. or over, shall be provided with tires not less than 3 ins. wide, and vehicles weighing 5,000 lbs. or over shall have tiers not less than 4 ins. wide.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was caused by a rock slide on the Northern Pacific R. R., near Paradise, Mont., Nov. 10. A passenger train ran into the slide and the engineman was killed, while the fireman was badly injured.

A LOCOMOTIVE BOILER EXPLOSION occurred Nov. 5, in the yards of the Southern Ry., at Atlanta, Ga. The engine had just come in from Chattanooga, and was in the cleaners' hands. Two men were killed.

A RAILWAY BRIDGE COLLAPSED under a wrecking train, Nov. 1, near North Adams Junction, Mass., on the Boston & Albany R. R. The derrick had not been fully secured and had slewed so as to strike one of the trusses. The engine and cars went down, but the crew jumped and nobody was hurt.

A BROKEN CRANKSHAFT on the twin-screw steamer, "Fuerst Bismarck," of the Hamburg-American Line, on its latest trip to New York, obliged the vessel to finish its trip with only the port engine working. The crack developed just beyond the after crank cheek of the crank of the low pressure cylinder of the starboard engine. A spare shaft was carried, and this was fitted in place in time to allow the ship to sail on Nov. 14, as scheduled.

A FLY-WHEEL BURST in the power house of the Rochester, N. Y., Gas & Electric Co., on Nov. 6. The wheel was 18 ft. diameter and 42-in. face, and weighed about 20 tons. One of the flying pieces struck the steam pipe above the engine, breaking the pipe and allowing steam to escape, by which the engineer was seriously burned. Other fragments passed through the ceiling of the engine room into the dynamo room above, wrecking it, and putting a portion of the city in darkness. The probable cause of the accident is not given in the press reports, other than the statement that the wheel was defective.

FOUR BOILERS EXPLODED at the Centralia colliery, Shamokin, Pa., on Nov. 7, killing four men and causing a loss of $10,000. The four boilers were in a group of 16. It is stated that one of the men, who was fatally injured, saw steam issue from a crack in one of the boilers, and shouted a warning, but the explosion took place before any one could get out of the boiler house.

A SAW-MILL BOILER exploded at Summersville, W. Va., on Oct. 22, killing three men and injuring three others. Pieces of the boiler were thrown several hundred yards.

THE U. S. BATTLESHIP "TEXAS" sank in the East River on Nov. 9. Fortunately the mud in the bottom of the river in front of the Brooklyn Navy Yard, where the vessel was stationed, was only a few feet below the keel, so that the sinking was not a serious matter as it would have been if it had happened in the middle of the river or at sea. The ship was raised the next day, and the total damage, it is said, will not reach $10,000. The true cause of the accident will not be known until after an investigation by a court of inquiry, which has been appointed by the Secretary of the Navy, but from the imperfect reports now available it appears that it was due to the breakage of a 13-in. sea-cock, through which water enters to supply the condensers, and the filling of the engine-room compartment by water. It is also stated that the bulkhead doors between the engine-room failed to hold water. The accident should lead to a thorough investigation of the water-tightness of compartment doors and of the strength of sea-cocks.

THE LEAKY RESERVOIR AT MONTREAL has been reported on by Prof. C. H. McLeod, of McGill University, and Mr. J. O. A. La Forest, Acting Superintendent. The reservoir has a capacity of 42,000,000 U. S. gallons and is formed by a masonry wall, backed first with puddle and then with an earth and stone embankment. Hook gage measurements, with allowances for evaporation, showed that with 23 ft. of water the level fell at the rate of 2.302 ins. in 24 hours, the test lasting 13 hours, or at the rate of about 350,000 U. S. gallons per 24 hours. With 18 ft. of water the leakage was at the rate of 120,000 U. S. gallons per 24 hours. Mr. La Forest believes the leakage is caused by the ice action near the high water line. Both he and Prof. McLeod recommend that the upper portion of the walls be repointed before cold weather sets in, as a temporary measure. Prof. McLeod suggests that "it might be well to consider the advisability of coating the walls with a waterproof wash." The water committee has been instructed to have the repointing done, as recommended. Mr. La Forest states that the high level reservoir, with a capacity of about 1,900,000 U. S. gallons, leaks 54,000 U. S. gallons a day, making the leakage of the two reservoirs more than 400,000 gallons a day. It costs $8 per day to pump the water wasted, in addition to which the leakage from the larger reservoir passes to the grounds of McGill University where, according to Prof. McLeod, it "constitutes a very serious source of injury to the buildings and grounds of the university."

A MUNICIPAL ELECTRIC LIGHTING PLANT for Des Moines, Ia., is recommended by Mr. John MacVicar, Mayor, after a somewhat extended investigation of the subject. Public lighting now costs the city $53,500, divided as follows: Electric street lamps, $31,696; electric lights for city hall, $2,202; gas street lamps, $5,724; gasoline street lamps, $13,888.

MUNICIPAL BONDS are now in active demand, where a month ago they could hardly be sold on any terms. The city of New York, which in September could not obtain bids for its bonds at all, opened bids on Nov. 10 for 3½% bonds to the amount of $16,000,000. There were no less than 185 bids received and the total of all the bids reached the enormous sum of $181,000,000.

A NEW STEAM GARBAGE SCOW for the city of New York was launched Nov. 9 from the Crescent ship yards of Mr. Lewis Nixon, at Elizabethport, N. J. The boat, which has been christened the "Cinderella," is a twin-screw vessel, formed of two pontoons with a garbage compartment between, having an estimated capacity of 600 cu. yds.

A FAST RAILWAY RUN was made on the Chicago, Rock Island & Pacific Ry., Nov. 8, by a train carrying a party of the Western Society of Engineers from Davenport back to Chicago. The run of 181 miles was made in 3 h. 41 mins., or 3 h. 30 mins. actual running time. The distance of 163 miles from Moline to Blue Island was made in 176 minutes running time, excluding three stops.

MUNICIPAL HOSTILITY TO RAILWAY CORPORATIONS is the main reason given by Judge Biddle at Carlisle, Pa., for refusing the petition of the people of Riverton to have the tracks and property of the Cumberland Valley R. R. and Northern Central R. R. included in the new borough. The former road has large and busy terminal yards, while the latter has a traffic of 40 trains daily. The following is an extract from the decision:

> From recent litigation we know that inharmonious relations exist between the inhabitants of Riverton and the two companies above referred to, and this makes manifest the fact that if the tracks of the latter should be brought into the borough, the business thereon would be liable to be much hampered by ordinances relating to the speed of trains, crossings at grade, employment of watchmen, and other matters in regard to which the authorities of a town are at times prone to legislate. On account of the unusual amount of train work which is done at the locality in dispute, severe damage, both to the stockholders and to the public could be inflicted by an unreasonable or hostile council. We have no hesitation in laying down the broad abstract proposition that it is directly contrary to public policy to unnecessarily subject the corporations of a railway to local municipal control, and, therefore, as no necessity or even reasonable cause for doing so appears in this case, the court would not be justified in granting the prayer of the petitioners.

THE PLANS FOR THE BASCULE BRIDGE over Newtown Creek, Brooklyn, N. Y., have been modified to the extent of increasing the span 24 ft., to give a clear span of 150 ft. clear of the fenders. The designs for the bridge were published in our issue of Nov. 5.

THE WORK OF THE BUILDING DEPARTMENT of New York city during the first nine months of 1895 and 1896 is shown by the following table, which is taken from the quarterly report of Mr. Stevenson Constable, Superintendent of the Department of Buildings:

	1895.	1896.	Increase in 1896.
Applications filed, new bldgs. and alterations	4,228	5,416	1,188
New buildings commenced	2,164	2,175	11
New buildings completed	1,703	2,480	777
Alterations commenced	1,094	1,465	371
Alterations completed	1,105	1,546	441
Iron and steel beams, girders, etc.	58,106	161,162	103,056
Violations of the law reported by inspectors	3,843	4,754	911
Buildings reported by inspectors as unsafe	1,705	2,666	961
Notices issued	10,704	39,457	28,753
No. inspections made of passenger elevators	2,632	4,257	1,625
Unsafe buildings made safe or taken down	1,204	2,510	1,306
Violations removed	2,722	4,628	1,906
Cases forwarded attorney for prosecution	2,714	2,772	58
Pass. elevator cases to attorney for prosecution	16	182	166
Defective pass. elevators reported by inspectors	62	856	794
Made safe on notice from Dept.	44	912	868
Notices of suits issued	5,075	5,284	209
Cases disposed of by attorney	2,841	4,522	1,681
Totals	101,962	247,044	145,082
Money collected by the attorney..	$5,778	$14,337	$8,558

THE STEEL ARCH ROOF FOR THE CHICAGO COLISEUM.

(With inset.)

One of the largest single span steel arch roofs erected in this country since the construction of the great buildings for the Columbian Exposition at Chicago is that recently completed to cover the main auditorium of the Chicago Coliseum, a building designed for convention and exhibition purposes and located about on the site of the "Wild West" show, so familiar a side feature at the great World's Fair of 1893. It is of passing interest to note that this same "Wild West" show was the attraction which inaugurated the recent opening of the building to the public, and perhaps of more interest to some of our readers—of certain political affiliations at least—to note that it was the scene of the struggle which signalized the choice of a Presidential nominee at the Democratic convention held July 7. It is for great exhibitions and assemblies of this kind that the Coliseum is designed. It is the magnitude of its steel roof, however, and not its uses, that makes the structure worthy of description in Engineering News.

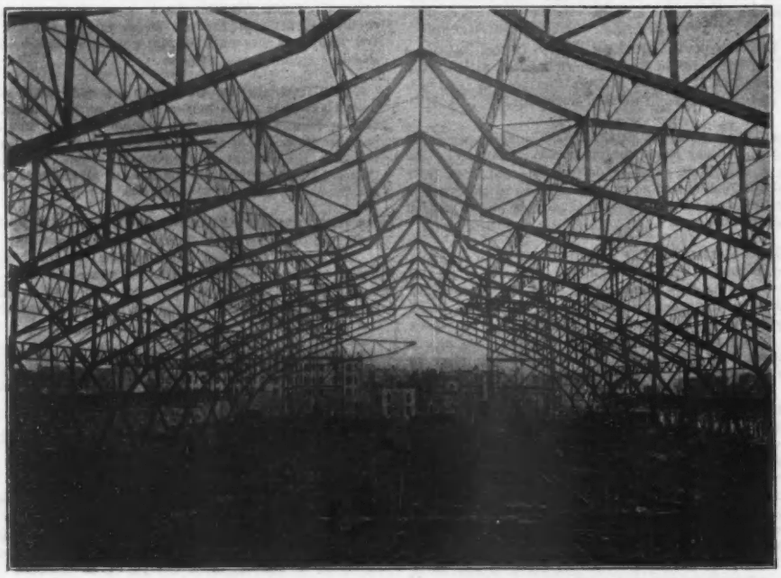


FIG. 11.—INTERIOR VIEW SHOWING ROOF ARCHES CHICAGO COLISEUM

The dimensions of the roof arches of the Coliseum as compared with those of a number of other large arch roofs, are as follows:

	Span c. to c. end pins.	Clear height at center.	Width out to out.	Length out to out.	No. pairs of arches.
	ft. ins.	ft. ins.	ft. ins.	ft. ins.	
Manufactures' Bldg.*	368 0	206 4	787 0	1,687 0	18
Mach. Hall, Paris Ex.*	364 0	147 7	480 0	1,380 0	20
Pa. R. R., Philadelphia	300 8	100 4	304 4	589 0	10
Pa. R. R., Jersey City	252 8	86 0	256 0	652 6	12
P. & R. R. R., Phila.	259 0	88 0	266 0	506 8	11
Mid. Ry., London	240 0	100 0	.....	600 0	..
Chicago Coliseum*	215 0	73 10	300 0	675 2	6

*These figures of length and width include the area covered by shed roofs and side galleries, except in case of the Coliseum where the end vestibule and ticket office is not included.

Most of the above structures have been described in previous volumes of Engineering News; the two Pennsylvania R. R. train-sheds, Sept. 26 and Oct. 3, 1891, and June 1, 1893; the Philadelphia & Reading R. R. trainshed, Jan. 19 and Feb. 2, 1893, and the Manufactures Building and Paris Machinery Hall, Sept. 1, 1892. No roof arches yet built have exceeded in span those for the Manufactures Building at the Columbian Exposition; and including shed roofs, no building yet constructed has ever had so great an area of ground plan.

As a matter of some interest, the capacity of the Chicago Coliseum as compared with the capacities of some other buildings designed for public gatherings, is given below from figures made public by its architect, Mr. S. S. Beman, of Chicago:

Name of Building.	No. people.	Name of Building.	No. people.
Chicago Coliseum	50,000	St. Sophia, Constantinople	23,000
St. Peter's, Rome	54,000	Notre Dame, Paris	21,500
Cathedral, Milan	37,000	Cathedral, Pisa	13,000
St. Paul's, Rome	32,000	St. Stephens, Vienna	12,400
St. Paul's, London	31,000	S. Dominic's, Bologna	11,400
St. Petronia, Bologna	26,000	Cathedral, Vienna	11,000
Cathedral, Florence	24,600	Madison Sq. Garden	8,433
Cathedral, Antwerp	24,300		
St. John Lateran, Rome	23,000		

The manner of seating the large assemblies which the Chicago Coliseum will accommodate will vary somewhat according to the extent of main floor required for exhibition purposes. Two stationary galleries extend around the building on all four sides and these are provided with permanent seats, but the seats on the main floor are movable and will be arranged to suit conditions. Only the weight of the audience in the galleries comes on the framework of the building.

The Chicago Coliseum is 675 ft. 2 ins. long without the vestibule, and 300 ft. wide in its outside dimensions. In Figs. 1 to 4 inclusive, are shown a number of plans and sections which give in diagram the principal features of the steel framework. Corresponding members in the sections and plans are lettered alike, so that reference from one to the other is easy. It is obviously impossible to show within reasonable space the details of all members and the detailed drawings here will be confined to a few of the most interesting features only. From these and the diagrams, Figs. 1 to 4, the nature of the construction will, we think, be reasonably clear.

Fig. 1 is a plan of the roof framing, showing the main roof arches, lateral bracing, purlins, shed roof trusses and their supports. Fig. 3 is a part plan of the gallery framing, and Figs. 3a, 3b, 2 and 4 show the above framing in section. There are twelve main roof arches connected in pairs. The two arches forming each end pair have the outline shown by Fig. 5, and the eight forming the four interior pairs have the outline shown by Fig. 6. The main difference between these two styles of arches is at the apex; the apex of each interior arch being raised at the demand of the architect so as to give the building an appearance of height to correspond with its great lateral dimensions, and yet to obtain as far as practicable the advantages of easy heating which a low roof presents. This form of apex was also influenced by the style of skylight framing and roof construction adopted by the architect, as it saved a vertical ridge frame for the ridge skylight and considerable supplementary ironwork; in brief, it was considered a cheaper and practically as satisfactory a construction by the engineer under the conditions imposed upon him. A study of the strain sheet, Fig. 6, showing the apex members will enable the reader to determine for himself the sufficiency of the design. Fig. 2 shows the two styles of arches side by side and also shows the span, height, foundations, etc. It will be noticed, particularly, that the horizontal thrust is taken by the foundations, there being no tie rod between end piers. The strain sheets show this thrust and also the strains in all other members of the arches under various conditions of loading.

The arch roof covers the main auditorium and the shed roof provides for a gallery and extends the main floor beyond the feet of the main arches, as shown by Fig. 2 and Fig. 4. At the side of the building the trusses forming the shed roof and carrying the gallery are carried by the girders and arches Fig. 3b and the wall columns Fig. 2, the construction being quite simple. At the ends the trussing necessary to carry the shed roof is somewhat more complicated, as shown by Figs. 2 and 4, but will be easily understood from the drawings, Sections Y. Z. and N. S. The part longitudinal elevation, Fig. 4, shows the timber roof carried by the steel framework, and it is also indicated in outline on Section Q. R., Fig. 2. This timber roof was used partly for architectural appearance and partly to provide for skylights, the architect fearing that such lights in the plane of the roof would not be satisfactory under snow load and on account of leakage, and also that the cost would be greater.

The framework of the arch roof comprises besides the arches proper 17 lines of purlins and wind bracing. The purlins between the pairs of arches differed from those between the arches of each pair as indicated by Fig. 3a. The purpose of the bracing below the purlins in the latter case is of course for the purpose of holding from lateral motion the lower chords of the arches. With the other type of purlins the lower chord is stiffened simply by a knee brace, Fig. 3a. The wind bracing is in the plane of the top chord of the arches and its character is shown by Fig. 1.

FIG. 12.—EXTERIOR VIEW SHOWING STEEL ROOF FRAMEWORK AND PARTLY COMPLETED SIDE WALLS.

In the foregoing the general arrangement and nature of the steel work is pretty clearly indicated and attention may now be turned to the composition and some of the details of the various arches, girders, purlins, trusses, etc. The main roof arches will be considered first. They are three-hinged arches and the details of chief interest are the feet and bearing shoes and the apices. Fig. 7 is a detail of the arch foot and Fig. 8 details of the shoes. These drawings give all dimensions and need not be described further. Fig. 9 is a detail of the apex of the arches of the form shown by Fig. 6, that is the eight interior arches. This detail is of especial interest in connection with the peculiar shape of the arch at the apex—the reasons for which were stated above.

The composition of the purlins, girders and other trusses is of one type, viz., riveted triangular truss work. The members consist of one or more angles with riveted plate connections; generally the chords consist of two angles and the web of single angles. The shapes of the various trusses are indicated clearly in the general plans, Figs. 1 to 4. All material was steel and was required to show a tensile strength of 58,000 lbs. to 68,000 lbs., an elastic limit not less than 32,000 lbs., an elongation of 22%, and a reduction of area of 45%. The assumed loads for which the metal work was calculated were as follows:

	Per sq. ft.
Dead load	25 lbs.
Live load, vertical snow and wind	20 "
Live load, horizontal wind	30 "
Purlins:	
Dead load	12 "
Live load, vertical	30 "
Gallery and roof girders:	
Dead and live loads	80 "

In tension the maximum allowable strains were for main trusses 16,500 lbs.; for purlins, 14,500 lbs., and for gallery and roof girders, 15,000 lbs. per square inch. In comparison the maximum strains were, for the main trusses, those obtained by the formula,

$$\frac{15{,}000}{1+\frac{L^2}{36{,}000\,r^2}},$$

and for the purlins and gallery and roof girders, respectively, the same with the numerators 14,000 and 14,500, in the formula. The possible conditions of loading assumed are shown on the strain sheets Figs. 5 and 6.

The extent and general character of the steel work have been pretty clearly shown in the foregoing, but additional clearness will be given to the construction by the photographic views Figs. 11 and 12. The first of these is an interior view along the longitudinal axis of the building and shows the truss work and purlins principally. The second is an exterior view and shows the side walls partly completed and also gives a rather impressive view of the network of roof framing. In Fig. 11 it will be noticed that at the far end one of the roof trusses is being erected, the right half being nearly at full elevation and the left half part way up. The traveling towers used for erection are also shown in this view and more clearly by Fig. 13. Each half arch was assembled complete on the ground and raised into position by tilting up the apex. After the erection of the roof arches the other framing was put in place by means of hoists and derricks placed on the roof.

As the readers of Engineering News already know (Eng. News, Aug. 29, 1895), a serious accident occurred to this building during its construction, and although the data are not available for a full discussion of the causes of this accident, a few words may be said in regard to its occurrence. The accident took place Aug. 21, 1895, after twelve main roof arches and most of the other roof framing were in place, although probably not fully connected, and resulted in the collapse of all but one of the roof arches. The collapse occurred at night when no one was at work, so that no person was hurt, and as far as known it occurred unwitnessed. The accident is stated by the engineer and designer to have been due probably to the fact that roofers had concentrated large loads of boarding and other timber at various points on the roof, thus increasing the strain to a dangerous point at places and at a time when the framework was not in the best condition to withstand it. After the collapse the steelwork was entirely rebuilt and it is of course this second structure that is shown by the illustrations accompanying this article.

The architect for the Chicago Coliseum was Mr. S. S. Beman; the general contractors were the Probst Construction Co., and the designer of and contractor for the steel work was Mr. Carl Binder, all of Chicago. The material was furnished by the American Bridge Works and inspected by G. W. G. Ferris & Co., also of Chicago. The building was erected by the Chicago Exhibition Co. For the drawings from which our illustrations are prepared we are indebted to Mr. Carl Binder.

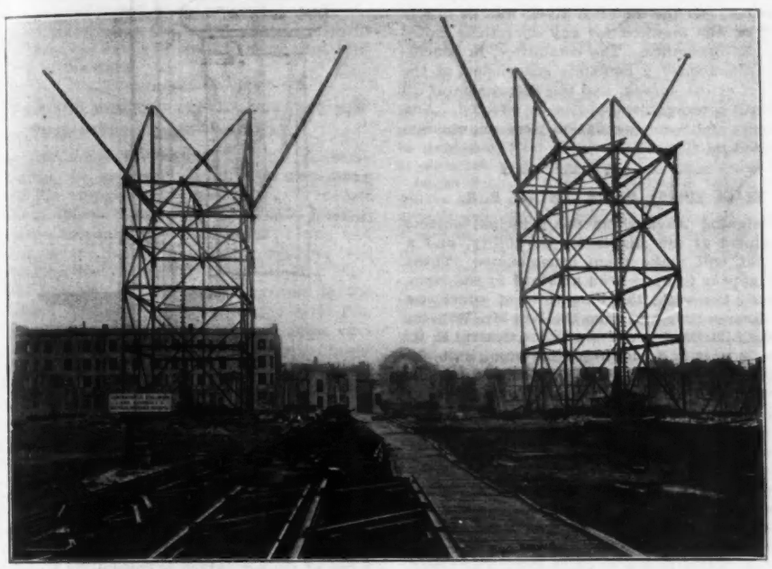


FIG. 13.—VIEW SHOWING TRAVELERS USED IN ERECTING ROOF ARCHES.

THE EXHIBITION OF VALVES AND HYDRANTS at New York city, which was to have been held on Nov. 10, has been postponed to Nov. 17. The exhibition will be at the Corporation Yard of the Department of Public Works, 437 East 24th St. All exhibits must be at the yards by Nov. 14. Col. Chas. H. T. Collis, 150 Nassau St., is Commissioner of Public Works, and Mr. A. G. Gear is General Foreman Corporation Yards.

THE TOPOGRAPHICAL SURVEY OF BALTIMORE, MD.

In connection with and as a necessary preliminary to projected municipal improvements in the city of Baltimore, Md., a thorough topographical survey of that city was authorized by an ordinance passed on April 26, 1893. A commission was appointed made up of the Mayor, City Register and City Comptroller, and Col. H. T. Douglas, M. Am. Soc. C. E., was selected as the Chief Engineer of the survey. The first section of the ordinance called for "a thorough, accurate and comprehensive geodetic and topographical survey" of the city of Baltimore, beginning with the recently annexed district. From these surveys official maps were to be made:

> On a scale sufficiently large to show clearly the following details: All streets and alleys as now laid out, with their width between the building lines; the elevation of streets above mean tide, at street corners or at other points, as may be necessary; the dimensions of blocks in feet and inches; all streets not yet opened to be located by dotted lines and their grades established, with a view of conforming to a uniform system of surface drainage or underground sewerage, and the survey made of the unimproved and undeveloped portions of the city shall be such that there may be defined on said map, all streams, water-courses, highways, boundary lines of farms or estates, with the names of the owners thereof; the undulations of the ground to be shown by contour lines representing the different elevations in a manner to enable the establishment of grades, locations of sewers, etc.

The second section of the ordinance provides:

> That plats be also made from said surveys and bound in atlas-form for the use of the Tax Department, City Surveyor and Commissioners for Opening of Streets, etc.; said plats to be made on a scale sufficiently large to show, in addition to the matters contained in the general official map the following details: The dimensions of each lot or tract of land embraced in the city, with the character of the improvements thereon; the location of all sewers, with their dimensions; the system of water supply, with the location of all fire plugs; all corporation buildings, such as school houses, station houses, etc., all railway lines, and such other details as may be considered requisite.

This work was commenced at once under the direction of Chief Engineer Douglas, and a primary triangulation was made covering 54.7 sq. miles of territory. This was followed by precise traverse and leveling parties, and 1,964 bench marks were established over 26 7-10 sq. miles of area by Dec. 31, 1894. In the same time the topographical party had covered 11,200 acres of territory. The report which gives the above figures also states that the final probable error in the length of the whole base-line was 1 in 354,432 in one line, 1 in 985,334 in another and 1 in 15,000,000 in a third comparison. In precise leveling the computed probable error was 0.614 mm. per kilometer, or less than 1-50th in. per mile. In comparison with similar work by the Coast Survey and Mississippi River Commission this was claimed to be the best on record. The total area embraced by the maps of this topographical survey was approximately 32 sq. miles, though the primary triangulation covered 54.7 sq. miles. The scale of 200 ft. to one inch, or 1:2400, was adopted for plotting the topographic maps, and 40 ft. to one inch for the property maps. The field work was done by transit and stadia, or plane-table and stadia, on the same scale of 1:2400, requiring extreme minuteness and accuracy in drawing. The details of the maps, completed in the field, were to be filled in by direct measurements of directions, or azimuths and distances from each topographic station, with occasional measurements for plotting of details with tape. Free use of the telemeter was made in locating elevations or in tracing contours.

Early in the present year some complaint was made as to the methods and results of this survey, and by joint resolution of both branches of the City Council a committee was appointed to examine into and to report upon the character and condition of the topographical survey of Baltimore. This committee reported in August, 1896, and from their report the following is taken: The committee held six public meetings and heard the testimony of a number of city surveyors, engineers and others interested, and it appointed two experts, Messrs. John W. Donn and John E. Sadler, to examine the work and make tests of the accuracy of the work as they deemed proper.

These experts recently reported that they were satisfied that the work of the triangulation division of the survey had been thoroughly and accurately done, and that the measurements and adjustment of angles and the computations of sides of the triangles had been as accurate as

those of any survey ever made. The work of the precise levelling party was also thorough and accurate and the bench-marks established will furnish valuable and reliable data for the use of engineers in any part of the city. But, say the experts, no matter how thorough, accurate and comprehensive may be the methods serving as a basis for such a survey, the results are only valuable when accurately shown on maps of detail.

They then find fault with the methods of securing details for map-making, and say that from the methods adopted it was impossible to show these details upon a map in the manner prescribed by the ordinance. The ordinance calls for all measurements in "feet and inches," whereas all office records and field note-books show that the corners of streets, width of streets, dimensions of blocks, etc., were determined in meters, not in feet and inches. These details were obtained by transit and stadia, and the stadia measurements were generally read only to the nearest meter, and in going over 30 or 40 field-books not more than 1 in 100 measurements is made to a nearer degree of accuracy than one-half meter. One-half a meter is nearly 20 ins., or more than 1½ ft., and when distances are required in "feet and inches" on a map, it is difficult to see how they can be determined when the measurements in the field are made only to meters, of nearly 40 ins.

The work of the draftsmen was found to be excellent, and as they practically merely inked in the completed maps made in the field, they can not be held responsible for errors. The experts then tested the accuracy of field-sheets reported as finished and for the purpose used a Johnson plane-table, a special Fauth alidade, a steel tape and an alinement rod furnished by the Chief Engineer of the survey. They reported that they considered the plane-table and alidade furnished as extremely inefficient instruments for the purpose intended, and not adapted to work of a critical character. The table was very unstable and had neither tangent screws for exact orientation and alinement, nor levelling screws for horizontal adjustment. The alidade, specially designed for this survey, was also an inferior instrument, according to the experts, badly balanced, too light and too small to allow easy handling. They report that without exception every station occupied developed errors in details, on some sheets varying from 1 to 14 ft., and these not in one invariable direction only. The reading of the telemeter to the nearest meter was responsible, for many of the smaller errors; imperfect plotting in the field caused others; and the absence of direct control over the work by a single observer in each party engaged was everywhere apparent. Many important details were omitted and small details on the ground plan of houses were left out, or in error.

Careful examination of the sheets show that the chief object of the engineers was to secure the accuracy of traverse stations, with seemingly scant consideration given to the exact location of topographical details. The record of distances given by stadia to the nearest meter is an evidence of this. On a scale of 1 : 2400, or 200 ft. to 1 in., a measure of one foot is distinctly appreciable, and in standard plane-table work an error of 3 ft. on this scale is annoyingly felt. The report goes on to say that

> This sensitiveness of the instrument makes it unapproachable by any other device or method used, for its excellence in critical work or the work of inspection. Angles measured are correct, although their value trigonometrically may not be exactly known because of the impossibility of protracting them to very small measures of arc. In graphical descriptions, however, such knowledge is rarely required, and if any exigency should call for a statement of trigonometrical value, the finely graduated arc of a transit or theodolite would be necessary for their measures. Topographical studies are best made from graphical delineations and the methods by which those delineations can be most quickly and accurately given, afford the most useful, economical and decisive results. An accurate topographical survey can have but one definition—that the results graphically shown are strictly graded to the power of the scale used. Two-tenths of a foot are definable by a scale of 1 : 600, four-tenths by a scale of 1 : 1,200 (100 ft. to 1 in.), and on a scale of 1 : 2,400, a foot is very easily discernible. In plane-table practice, the whole field encompassed by the scale of the work on a sheet of paper of convenient size is directly controlled by the topographer, and at any time he is able to have under inspection, his work already accomplished.

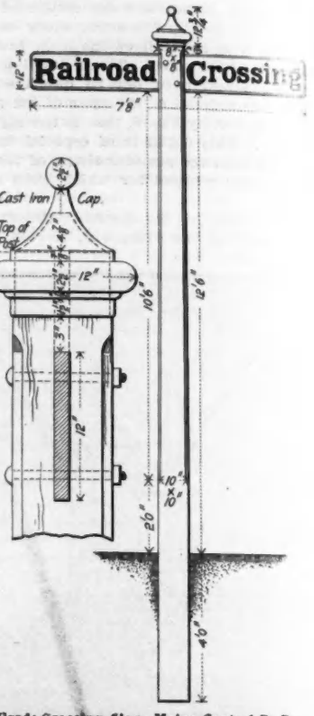
The experts object to the manner of marking the traverse points, by driving a gas-pipe into the ground under the pavement, for example, and say that these can not be regarded as permanent, and they also find fault with the contour system.

The investigating committee also called in Mr. O. H. Tittman, assistant in charge of the office of the U. S. Coast and Geodetic Survey at Washington. He compared the maps and the ordinance, and testified as follows: That the maps do not contain the width of streets, lanes and alleys, and the length of blocks in feet and inches, nor elevations at street corners, etc., as required by the ordinance. None of these details could be found on the 25 published maps. The committee also called attention to the cost of the survey, which has been $160,000 up to the present time, or about $9.50 per acre of the area covered. As a partial explanation of this excessive cost, more than that of other topographical surveys, it is stated that several thousand dollars were expended in correcting a distance given, in error, by the U. S. Coast and Geodetic Survey, between the Washington Monument and Bay View. The committee deems the money spent in correcting this error as unnecessary, as the distance given was as nearly correct as was required for any operations called for by the ordinance. The committee, in conclusion, recommended a complete suspension of the personnel of the survey, and the suspension of all work until a reorganization can be effected. And this report and recommendation were unanimously adopted on Oct. 12.

TRACK SIGNS; MAINE CENTRAL R. R.

In designing track signs the principal objects to be aimed at are simplicity, durability, and a style that will make them conspicuous. These objects appear to have been attained in the signs illustrated herewith, the blueprints of which we received some time ago from the late Mr. William A. Allen, Chief Engineer of the Maine Central R. R.

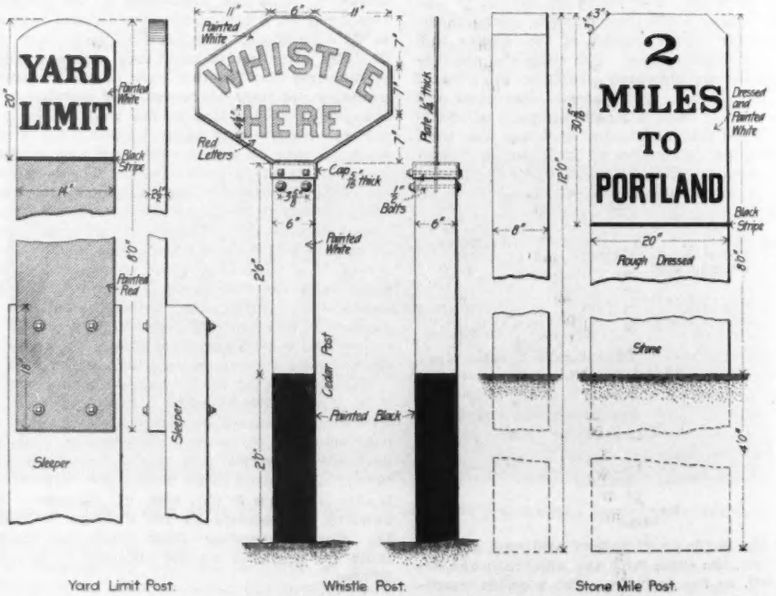
The mile post is a rough-dressed stone slab, 12 ft. long, 20 ins. wide and 8 ins. thick, set 4 ft. in the ground, and having 30 ins. at the top dressed smooth for lettering. The unusual height is evidently on account of the heavy snows encountered. The dressed faces are painted with three coats of white lead, with lettering in black and a 5-16-in. black stripe. The post is lettered on both faces, the one shown being lettered "249 miles to Vanceboro" on the back. The yard limit sign is a 2½-in. plank, 14 ins. wide and 8 ft. long, with the bottom bolted to a post or sleeper. The lower part is red and the upper part white, with black letters and a black stripe. The whistle sign differs



Grade Crossing Sign, Maine Central R. R.

from the usual style in having the words "Whistle Here" instead of merely a W. It is a ¼-in. iron plate of diamond form, 28 × 21 ins., let 4 ins. into a 6 × 6-in. cedar post whose top is 4 ft. 6 ins. above the ground and is covered with a cap. The bottom of the plate is secured by four ½-in. bolts, the upper ones 7¾ ins. and the lower ones 7¼ ins. long. The post is painted black to a height of 2 ft. above the ground, and thence white. The plate is given two coats of red lead and four coats of white lead, and is lettered in English vermilion.

The grade crossing sign is a 1¼-in. board, 7 ft. 8 ins. long, and 12 ins. wide let into the slotted top of a post about 18 ft. 2 ins. long, set 4 ft. into the ground. The post is 10 × 10 ins. to a height of 2 ft. above the ground and then diminishes to 8 × 8 ins. at the top, which is covered by a cast-iron cap. The board is secured by two bolts. The post and board are painted white and the board has a



Yard Limit Post. Whistle Post. Stone Mile Post.

TRACK SIGNS, MAINE CENTRAL R. R.

3-16-in. black border stripe ¼-in., from the edge. The capital letters are 7¾ ins. and the small letters 5¼ ins. high. The station sign is made of two thicknesses of ⅞-in. pine boards, the back board 25 ins. wide at the middle and 19¾ ins. at the ends, and the face board slightly smaller. The boards are put together with four screws and have

their edges beveled. The face of the sign is painted black and sanded. The letters are white, with gilt edging, and the scroll work is gray. Over the corner screws are 1½-in. gilt caps. This sign would be better if made with a rectangular board and having the painted flourishing omitted. In this

Station Name Board; Maine Central R. R.

connection it may not be amiss to refer to the almost universal insufficiency of station signs, especially at night, when the board on the platform or hung from the eaves of the platform shed roof is usually in the dark.

REPORT ON THE MODIFIED ROUTES FOR THE NEW YORK RAPID TRANSIT RAILWAY.

Since the adverse decision of the Supreme Court upon the construction of the Broadway route of the proposed underground rapid transit railway for New York city, the Rapid Transit Commission has taken up the Elm St. route, and a report on the modified route and plans was submitted on Nov. 5 by Mr. Wm. Barclay Parsons, M. Am. Soc. C. E., Chief Engineer to the commission. The accompanying sketch map, Fig. 1, shows the location of the route. A great saving in expense has been made by putting the lower part of the line on Elm St., instead of on Broadway, and by making the junction between the east and west side lines at 42d St. instead of at Union Square. A further great saving has been made by leaving off entirely that part of the line south of the City Hall; and this change seems to us open to criticism. A two-track line from the City Hall to the Battery could be built at no very great expense, and would be extremely valuable in drawing traffic to the system. Figs 2 and 3 are condensed profiles of the lines; Fig. 4 is a typical cross section on Fourth Ave. (differing from that on Elm St. only in having no subways for pipes), and Fig. 5 shows the proposed viaduct across Manhattan Valley.

The following is the report of Mr. Parsons, practically in full, omitting only some part of the discussion as to the definite route for the northern or suburban parts of the line:

On Aug. 6, 1896, the Board of Rapid Transit Railroad Commissioners passed the following resolution:

Resolved, that the chief engineer be and he hereby is directed to submit to this board, at as early a date as possible, the routes and general plans for a rapid transit railway, which shall conform to the following conditions:

1. The total cost, after abundant allowance for contingencies, not to exceed $30,000,000.

2. The route to proceed from the southern terminus at or near the Post Office, under City Hall Park and Park Row, Elm St. and Fourth Ave., to or near the Grand Central Station, and there to divide into an east side and a west side route. The west side route to proceed under 42d St., Broadway and the Boulevard to a point above 125th St. The east side route to proceed under Park Ave. and over private property to the Harlem River, and across and beyond the Harlem River to as great a distance as the proposed limit of cost will permit.

3. The railway to have four tracks to the junction of the east and west side routes, and above that point to have two tracks on each route, except that a third track for express service shall be added on both routes where conveniently and economically possible.

4. The road to be in tunnel, except on the east side route north of 98th St. and on the west side at Manhattan Valley.

5. The plans to be so drawn as to permit of extension in the future from the southern and northern termini, and of widening the two-track and three-track portions into four-track systems, without unnecessary expense or interruption of traffic.

Along the critical portion of the proposed route, i. e., Elm St., there was no information at hand showing the kind of material that would be encountered in excavating. I therefore caused to be made a series of borings, similar to those made along Broadway. This system of borings commenced at the corner of Chambers and Elm Sts., and extended to the corner of Fourth Ave. and 33d St., so that definite knowledge has been obtained as to the subsurface material. Above 33d St. the result of inquiries made of architects and builders, and the recorded data of sewer excavations of the Department of Public Works, have been sufficient to determine the probable rock line, with enough accuracy for this stage of the proceedings.

While the soil underlying Elm St. is very variable in character, more so in fact than was the case in Broadway, it is nevertheless an excellent material in which to conduct such construction as is proposed, being, with but few exceptions, a sharp silica sand, ranging in quality from what might be termed a good fine sand to coarse sand and gravel mixed, the latter material being found in large quantities. The few exceptions above referred to are streaks or deposits of clay, or clay and sand mixed.

To the depth for which the excavation for the railway will be made, there was no material found which would slide or give difficulty in handling, while much of it is a sand of such excellent building quality that it would pay the contractor to store and use it in the mixing of the mortar and concrete required on the work. Rock is met with first at 12th St., and is found, as a general thing, at or near rail level from there to 33d St., providing an excellent foundation along Fourth Ave. Above 33d St., and on both the east and west side routes, the rock surface undulates greatly and consequently a considerable portion of the excavation will be in that material, but to no greater extent than was anticipated in the original preliminary estimates for the same routes.

At the time of making borings along Elm St., the opportunity was availed of to determine the elevation of ground or standing water, which was found, in general, to be about 1 ft. above the level of mean high tide. If the new street grade at Pearl St. is changed in accordance with the suggestions made to your board on Sept. 9, and subsequently laid before the Board of Street Openings, the only part of the route where the rail level will lie below tide water will be along Elm St., from Leonard St. to a point midway between Howard and Grand Sts., a distance of 1,600 ft., with a maximum depth below tide water of only 5½ ft.

Maps showing the existing sewers, water mains, gas pipes, and electrical subways, have been prepared, and a tolerably complete study made as to their reorganization, especially in respect to the sewers. Elm St. lies either end, contains no pipe of large size, and what pipes are there now, will all be replaced on the opening and construction of the new street. At Fifth Ave. and 42d St. there occurs the most serious pipe crossing along the route, as the large Croton water mains run down the avenue. Fifth Ave, however, at that point forms a decided ridge, the surface of 42d St. falling rapidly both to the east and west. In order to have suitable grades for operating a railway, it would be desirable to pass sufficiently below the level of the avenue to leave all the water and gas pipes undisturbed overhead.

The portions of the proposed route that formed a part of the route previously adopted, were recognized as presenting no serious difficulty in construction. The physical investigations and survey of the newly considered portions show that they contain no features that will cause the road to be excessively expensive, slow, or difficult to build. The proposed route, therefore, escapes entirely the difficulties of construction which were present along Broadway, incident to the heavy traffic, cable railways, complications of sub-surface structures and the care of abutting buildings. The work can be attacked at as many points as can be conveniently operated at once, and the whole brought rapidly to completion at the same time.

In the resolution of instructions, the commission proposed a route on the west side as far as 125th St. and the Boulevard, and on the east side to 98th St. and Park Ave., leaving it to the discretion of the chief engineer to make suggestions for your consideration of routes above these points. On the west side, 125th St. will not make a satisfactory terminus, being in fact a point on the proposed viaduct over Manhattan Valley. If the line is extended to the neighborhood of 135th St. a station can be located over Manhattan Ave., which is the principal cross street in that part of the city, and, furthermore, the line can be carried completely across the viaduct and terminate in such shape that it can be readily extended at any time further north.

With the idea of building only so much of the railway as certainly will be profitable to operate at the outset, 135th St. will be a satisfactory temporary stopping place. The Third Ave. Ry. Co. has secured a franchise for a cable or electric railway to run over the Boulevard and Kingsbridge Road to Yonkers, and I believe arrangements have been made to commence construction in the spring. With this line in operation, the residents of Washington Heights, Inwood, Kingsbridge and even Yonkers, can be picked up and brought down by the surface line to 135th St., and there take a fast express train for points in the lower part of the city. The combination of express trains on the rapid transit road below 135th St., and the surface service above that point, will furnish rapid transit facilities to the upper district vastly superior to those now offered, and will tend to develop that section, and to demonstrate at an early date the profitableness of an extension of the rapid transit railway to 185th St., to Kingsbridge, or beyond.

On the east side, however, the question is not so easy of solution. The route as proposed by the commission is definite only to 98th St., where the Harlem R. R. emerges from the tunnel onto the viaduct. The rapid transit road

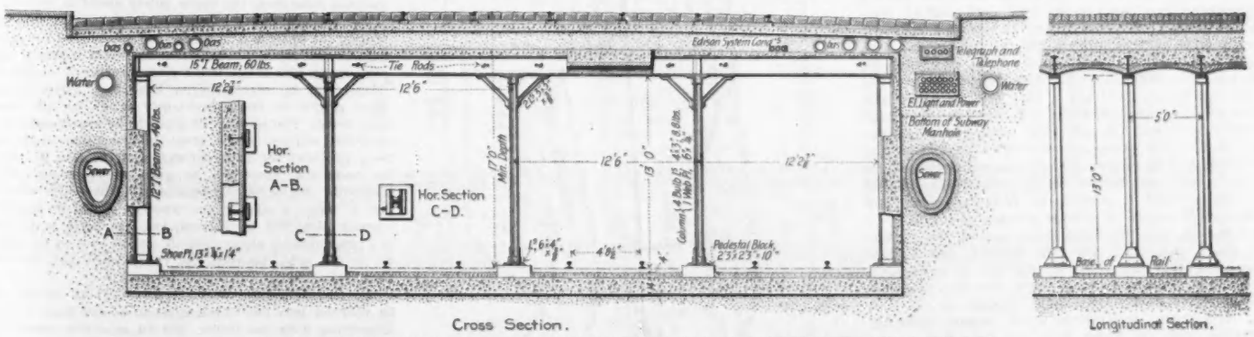


FIG. 4.—SECTION OF NEW YORK RAPID TRANSIT RAILWAY ON FOURTH AVE., NEW YORK CITY.

nearer the dividing ridge of the city's drainage system than does Broadway, and the taking care of the sewers will therefore be of less serious moment. The Canal St. sewer can be treated in a similar manner to that proposed in the case of Broadway, and approved by the Engineer of Sewers of the Department of Public Works; that is to say, to cut it at the place where the railway crosses, and build a new sewer to the East River, and to turn into that stream the flow from the district lying north of Canal St. and east of Elm St., which now passes west through the Canal St. sewer into the Hudson River. The amount of sewage so diverted will be less than was proposed with Broadway, as the district affected is not so great, and therefore the new sewer will be of smaller size than was previously anticipated.

No part of the route as herein contemplated is a main thoroughfare for water and gas pipes, or electrical subways, while Elm St., being at present with no outlet at

can be carried up Fourth Ave. along the side of the Harlem R. R. to the Harlem River, as was proposed before. This suggestion, however, met with the strenuous opposition of the abutting owners. If the line be carried to the east of Fourth Ave., it will be brought into close traffic conflict with the Second Ave. and Third Ave. elevated lines, and as these two roads already exist, it seems to me that the people residing in that neighborhood can be served at much less expense, and more immediately, by improving the facilities of those lines, rather than by building new ones.

In studying this question, I have considered the existence of the elevated railways, and have deemed that the best results for the city at large and for the parties who will construct and operate the rapid transit railway, will be obtained by building the new railways as far removed as possible from the present lines, leaving the latter free to take care of their legitimate traffic, but by improved

and extended facilities if necessary. The business of the street railways (including the elevated railways) in this city, is increasing at a rate 2½ times as fast as the population. The normal increase in traffic will not only provide a profitable business for the rapid transit road without drawing from existing lines, but makes it appear certain, if the past is any guide to the future, that at no very distant date both the existing lines and that proposed in this report, will be insufficient to properly care for the travel. I have, therefore, endeavored to study out a location that will allow the new and old systems to be developed from independent territory.

The Board of Experts under Mr. Hewitt, when considering this question, made a suggestion in regard to the desirability of laying out a line in the neighborhood of Lenox Ave. and north of Central Park. North of 110th St., between Eighth and Third Aves., is a portion of Manhattan Island which now supports a large population, and which is capable of supporting a still larger one, but which is wholly without rapid transit lines. This is the best field in New York city for creating traffic. If, therefore, instead of carrying the new route through and along Fourth Ave., or to the eastward of it, it should be carried to the westward of Fourth Ave., it would be removed from the existing railways and serve to create its own traffic, and would at the same time provide rapid transit facilities for a portion of this city's population which is now at an inconvenient distance from the elevated railways.

This region can be served by carrying the rapid transit railway up Fourth Ave., alongside of the Harlem R. R. to 110th St. From that point two alternatives are presented: (1) By laying out an elevated railway along some cross street, as for example 110th St., to Lenox Ave., and thence along and over that avenue to the Harlem River. Lenox Ave. is practically the only street that could be used for that purpose, as Madison and Fifth Aves. are prohibited by law, and Seventh Ave. is open to the same objection that Fourth Ave. would be, namely, that it is too near one of the existing lines of elevated railway. The other alternative would be to branch off at or near 110th St., pass through the rear of the lots abutting say on 110th St., to a point to the east of Lenox Ave., but sufficiently far to the west of Mount Morris Park to avoid the valuable residential property abutting on that square; thence turning to the right with an easy curve and running straight to the Harlem River, parallel to Lenox Ave. The right of way for this purpose from 110th St. would have to be acquired by purchase. This line prolonged across the Harlem River would reach the Annexed District at about 150th St.

The topographical conditions in the Annexed District are peculiar. The tracks of the New York Central, Harlem and New York, New Haven & Hartford railways, with the large yard at 161st St., divide the 23d and 24th Wards in two parts. To the east of the yard there is already a large population; to the west of it, and bounded on the east by the yard and a high dividing ridge, and on the west by another ridge, lies what is known as Jerome Valley, with Jerome Ave. running through the center of it. This valley covers nearly one-half of the two wards, and is entirely without transit facilities. Its surface is such that houses can be erected cheaply and close together, and it provides an area that could, and should, supply homes for a great number of people.

This section, and the other lying east of the railway yard, above mentioned, are two separate and distinct districts and it is impossible for one line to serve both. The easterly district, however, now has the Suburban Elevated Ry. and the Portchester Branch of the New York, New Haven & Hartford R. R., which latter, in connection with the Third Ave. and Second Ave. elevated lines of the Manhattan Ry. system, does a local business with trains at 30-minute intervals.

The Manhattan Ry. has already made certain propositions to your board, looking not only to the improvement and extension of its suburban line, but to the building of a new line which will extend as far north as Mount Vernon and lie well to the eastward of the suburban line. These extensions should be made at an early date and afford immediate relief to the populated portions of the 23d and 24th Wards, and if at the same time a third track were laid on the Third Ave. line, as the Manhattan Ry. Co. proposes, and so enable it to run a continuous express service, the upper part of the city would receive almost immediately a fair rapid transit service—much more quickly than it could by waiting for the rapid transit road itself. It would seem to be wise, therefore, to leave the district lying east of the Harlem R. R., to be served for the present by the improved facilities which can be afforded by the Manhattan Ry. Co. The extension through Jerome Valley could, therefore, be properly taken up as the line of the proposed rapid transit railway. It would be a direct northerly extension of the Lenox Ave. line and would secure for itself a large territory free from competing railways. There are two ways in which a line can be built in this territory. One would be, after crossing the river to build an ordinary elevated railway along Girard Ave. to its intersection with Jerome Ave., and then an elevated line along Jerome Ave. northward to such point as may seem desirable. The other would be, to acquire private property and build a railway (elevated, depressed, or on an embankment enclosed between retaining walls, as the topography of the land will indicate). In my judgment, Burnside Ave. would be a proper point to which to lay out the first installment of construction of this line, although in my estimate I have included the cost of the work to Fordham road. In my opinion, however, this additional outlay would serve a better purpose if applied to the construction of an extension from the Post Office to South Ferry.

The board, in its resolution, determined that four tracks

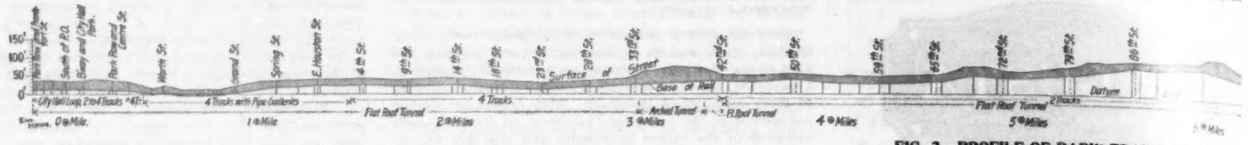


FIG. 2.—PROFILE OF RAPID TRANSIT RAILWAY.

should be constructed to 42d St. On the easterly extension, northward from that point, there is room for but two tracks on the west side of the Harlem R. R., and under or over Park Ave. to 110th St. On the line to the westward, from 110th St. to or near Lenox Ave., I have continued the two-track section, but from 111th St. northward to the Harlem River, I have estimated on a third track to be used for express trains. The station at 125th St. could be so arranged, by proper cross-overs, that an express train could either make a stop at 125th St., or could run through on the third track at high speed, in which case it would have an unbroken run from a point say 1,000 ft. north of the Harlem River, to a station at Fifth Ave. and 110th St., or over 2¼ miles.

On the west side line, I have estimated for a two-track road through 42d St. and up Broadway to 58th St., and a three-track road from there to 98th St. Stations at 60th and 96th Sts., at which points the board had previously laid out express stations, could be arranged in a similar manner to the station at 125th St. on the east side line, so that an express train could stop at either or both of these stations, or, if desired, could make a continuous run from 103d St. to 53d St., a distance of 2½ miles.

As soon as the traffic warrants it, complete four-track roads can be constructed on both the east and west side lines, so as to give a continuous express service, both north and south, at all hours. On Park Ave., north of 42d St., the space on the east side of the Harlem R. R. can be used for the additional tracks.

Supposing, however, the trains to stop at 125th St. on the east side, and at 60th and 96th Sts. on the west side, the following schedule, it is believed, could be successfully operated:

East Side.

City Hall to 42d St.	5½ minutes.
City Hall to 125th St.	21 "
City Hall to north side of Harlem River	24 "
City Hall to Fordham road	35 "

West Side.

City Hall to 60th St.	11 "
City Hall to 135th St.	21 "

If the 125th, 96th and 60th Sts. stops were omitted the running time from the upper points would be reduced.

The construction designs have been carried only sufficiently far to form a basis for estimates. For the greater part of the route the construction would naturally be in conformity with the detailed plans previously worked out. Along Elm St. pipe galleries have been designed somewhat similar to those previously drawn for the Broadway route. The number of pipes to be contained in these galleries will not be as great as those that would have been provided for in Broadway, and the Elm St. galleries need not, therefore, be quite so capacious. Along Lafayette Place and Fourth Ave., where the street is 100 ft. wide, a plan of construction similar to that previously designed for Fourth Ave. can again be adopted, the pipes resting either directly on the roof of the tunnel or at the side, between the outer walls and the curb lines.

The two and three-track portions of the railway can be widened into four-track systems at any time, without interfering with the traffic, and an extension south from the Post Office under Broadway, as well as extensions north from the suggested east and west terminal, can be made in like manner. The only radical change in construction from the previously considered plans, is the viaduct portion through the blocks north of 110th St. The part of the railway built on private property could be erected on brick arches supported on concrete piers. The streets could be spanned from house line to house line by steel arches, the masonry construction forming suitable and efficient abutments. These arches are designed to give, as the minimum of headroom, 12 ft. at the curbs, and 14 ft. at the centre of the roadway, which is greater than the minimum clearance of the Manhattan Ry. This arch construction, although costing considerably more than ordinary steel elevated spans, gives a structure that will be very economically maintained, one that will bear the heaviest and most severe traffic, one that will be almost noiseless, and one that will diminish the unsightliness of the railway to the minimum. The design is closely allied to the design of the famous Stadt-

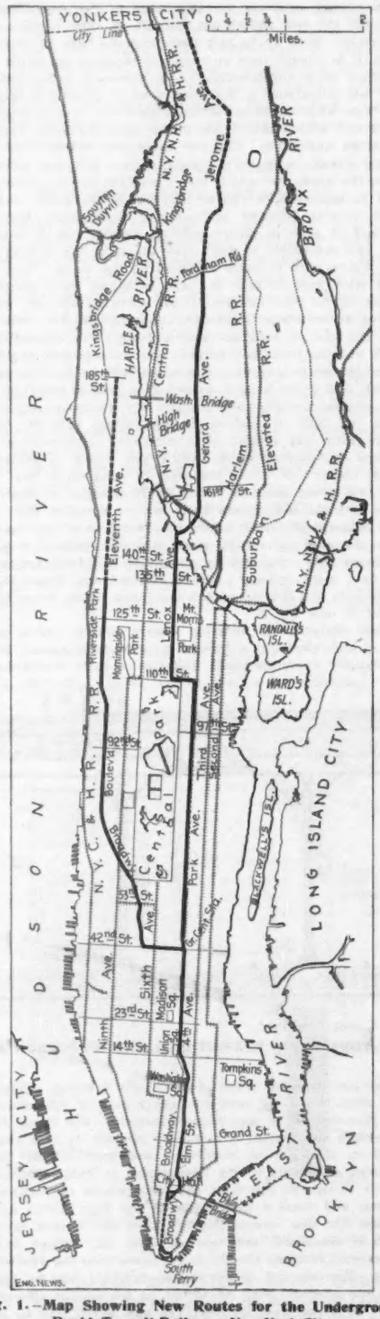


Fig. 1.—Map Showing New Routes for the Underground Rapid Transit Railway; New York City.

bahn to Berlin, which is very properly considered the finest piece of urban railway construction, where the objections to other similar railways in respect to noise and appearance have been so eliminated that high-class and expensive private residences have been built in its immediate neighborhood.

South of the Brooklyn Bridge Station, at City Hall, a complete loop can be constructed, so that there will be no switching or crossing of express and local trains. As the most convenient location for this loop would be around the Post Office, the opportunity is afforded to have a station in Broadway at that point. The cable pits of the Third Avenue Ry. Co. compel the line under Park Row to be depressed, and it will probably be found convenient to have the Post Office Station a few feet lower than the ordinary stations elsewhere, and thus the pipes in Broadway can be left undisturbed overhead. Two tracks have been projected to serve the Post Office on the Mail St. and Park Row sides, so that direct and constant communication can be had between the Post Office and Grand Central Station and much time saved over the present system of transfer by vans. Other tracks for the storage of trains or for sidetracking temporarily disabled trains can be provided. Should the newspapers whose offices are on Printing House Square and Park Row, desire it, it is possible to construct for them a special track on which, during the night, cars can be set, one or more for each newspaper, and into which the morning editions can be loaded directly from the press rooms through the vaults under the sidewalk. These cars can be taken to the Grand Central Station in five minutes on express trains and so save over half an hour on all papers sent north and east.

In estimating upon the plans herein proposed, the cost of real estate, as well as construction proper, had to be taken into account, as private property to a large amount will have to be acquired. To ascertain the probable cost of construction, profiles covering all the routes have been prepared, and stations located corresponding to the stations previously decided upon by your board in connection with the Broadway plans. The actual quantities of the different classifications of material to be excavated and the value of the material entering into the work, have been carefully computed. Prices have been assigned to the various items after consultation with large contractors and after taking into account the prices used in previous estimates, or as modified by the experience gained in similar work in Boston, or by recent large street excavations made in this city. The quantities taken and the prices allowed are, in my judgment, amply sufficient to complete the work.

The total mileage contemplated by this report is as follows:

Two-track	10.90 miles.
Three-track	3.99 "
Four-track	3.03 "
Total	17.92 "

I believe that the work, as described in this report and its accompanying drawings, including proper terminals and storage places, can be constructed and built in the most substantial and approved manner for an actual cash cost of $20,048,000, with an extra allowance of $1,200,000 for interest during construction. Although, in my judgment, the work can be completed for the sum named, I should advise that an extra arbitrary allowance be made to cover extraordinary contingencies, and such extras as human foresight cannot see. To cover all such contingencies, an allowance of 20% would, in my opinion be amply sufficient.

In order to estimate the cost of the right of way, I procured the advice of those conversant with real estate values, and, acting under such advice as the best means of proceeding, I ascertained the assessed valuation of all land to be taken. From Fourth Ave. to a point near Lenox Ave., I have estimated on a right of way 25 ft. in width, sufficient for two tracks, to be taken from the rear of the lots abutting on 110th St. From 110th St. north, I have estimated on a right of way with a minimum width of 40 ft. and a maximum of 50 ft., according as the lot lines occur. This minimum width of 40 ft. would be amply sufficient for the construction of three tracks. I have had a careful search made of actual sales that have taken place in this neighborhood during the past three years, and on comparing the same with the assessed valuation, I found that the ratio of assessments to sales reported (exclusive of those set down for a nominal sum) is about 50%. Although advised by real estate operators that an allowance of 10% would be sufficient to cover the increased valuations or improvements between now and the probable construction of the road, I have added in order to be liberal, 20%, as in the case of the construction estimate.

North of the Harlem River, a right-of-way width of 50 ft. has been assumed in order to allow for slopes in the cuts and fills, and to provide an ample margin for the addition of a third and fourth track in the future. There will be two other points on the road where property will have to be acquired, first at 9th St. and Astor Place, where the line will pass under the corner of a bloc order to diminish excessive curvature; and the other on which crosses private property to the point where it will reach Jerome Ave., is estimated to cost $698,328, extras included. The most reasonable elevated structure that it would be advisable to construct along Girard and Jerome Aves. for the same distance, would amount to $753,024, or $54,696 more. The right of way over this portion of the route is estimated to cost not over $230,000. As to whether this cost of land will be offset by abuttal damages on Girard and Jerome Aves., it is impossible to state. Probably some damages would have to be paid, but they are not likely to be excessive. The estimate for an outside provision of money falls short of the $30,000,000 stated in the resolution by $902,400. But I understood this limit to be set arbitrarily by your board, as a maximum limit not to be exceeded, and on the other hand not necessarily to be equalled by the estimated cost, provided satisfactory plans could be obtained for a less figure.

If the board should prefer to occupy the streets with an elevated railway, instead of using private property, the above estimate will have to be altered to some extent. For the masonry viaduct between Park Ave. and 110th St., to 140th St. (above which point to the Harlem River a steel viaduct will probably be constructed, curving to meet the bridge), the estimated cost is $1,665,040, interest and contingencies included. To build a high grade steel viaduct of the same capacity in regard to tracks, would cost $1,251,792, extras likewise included.

The cost of the right of way in this portion of the route is estimated at $2,537,600, but if an elevated railway were constructed in the street, damages for abutting property would undoubtedly have to be paid. What these damages will amount to I cannot, of course, precisely say. I have conferred with lawyers and real estate experts who have had experience in damage suits against the Manhattan Ry., and they are agreed that it is impossible to foretell, except within wide limits, what amount of damages the courts would be likely to award. The assessed valuation of the abutting property is $6,274,900, and, therefore, on the ratio of 50% between the assessed and actual valuations, the latter would be to-day $12,549,800.

North of the Harlem River the portion of the line

7th Ave. 110th St. and 4th Ave. 5th Ave. 111th St. and Lenox Ave. 116th St. 125th St. 135th St. 140th St. Harlem River Port Morris B.R. Approach to Cannel Bridge E. 144th St. E. 145th St. McComb's Dam Br. 157th St. Clarke Pl. Elliot Pl. 172nd St. Wash. Pl. Base of Rail Tremont Fordham Hill
Not Elevated Masonry Viaduct 3 Tracks Steel Elevated Surface Line Fill Fill 2 Tracks Cut Steel Elevated Datum Line
7 Miles 8 Miles 9 Miles 10 Miles 11 Miles 12 Miles from P.O.

NEW YORK CITY. (CITY HALL TO FORDHAM ROAD).

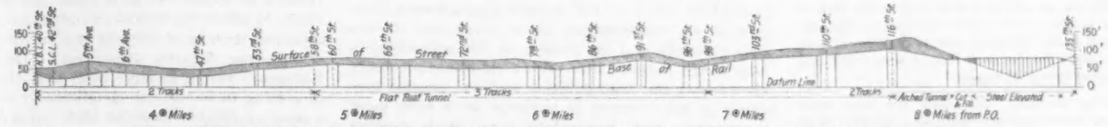

155th St. 5th Ave. 8th Ave. 42nd St. 53rd St. 59th St. 60th St. 65th St. 72nd St. 79th St. 86th St. 91st St. 96th St. 103rd St. 110th St. 116th St. 135th St.
Surface of Street Base of Rail
2 Tracks Flat Roof Tunnel 3 Tracks Datum Line 2 Tracks Arched Tunnel Cut & Fill Steel Elevated
4 Miles 5 Miles 6 Miles 7 Miles 8 Miles from P.O.

FIG. 3.—PROFILE OF RAPID TRANSIT RAILWAY, NEW YORK CITY. (WEST SIDE LINE, 40TH ST. TO 135TH ST).

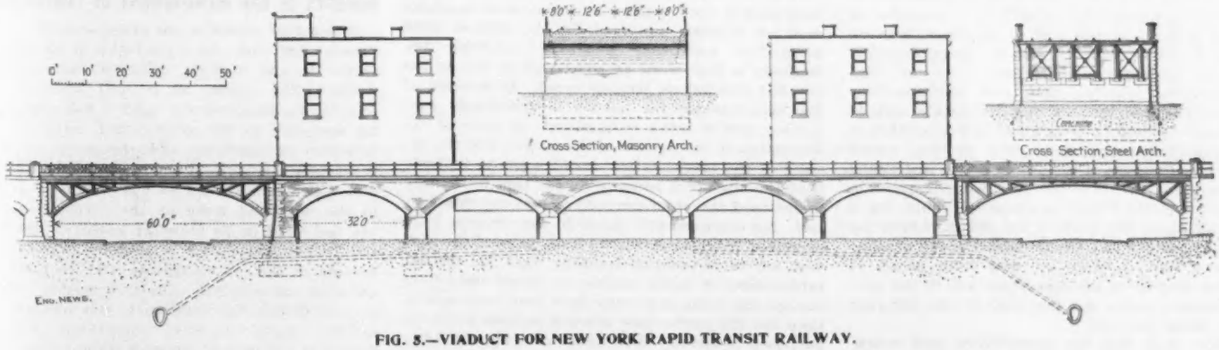


FIG. 5.—VIADUCT FOR NEW YORK RAPID TRANSIT RAILWAY.

Park Ave.., between 97th and 99th Sts., where the line emerges from the tunnel to the viaduct and where two tracks will take up the whole of the roadway between the buildings and the wall of the Harlem Railroad.

A certain strip would have to be acquired between those two streets in order to make a new roadway. The actual value of the real estate, determined on the basis as herein described, amounts to $3,000,000, and the cost of the railway complete, would therefore be as follows:

Construction	$20,048,000
Real estate	3,000,000
Interest	1,200,000
Total	$24,248,000

If to this be added the very ample amount for unforeseen contingencies already suggested, we have as an outside estimate of money which should be in hand for the work, the sum of $29,097,600.

I have made no provision for abuttal damages for the portion of the road in the tunnel. In my opinion there would be no damages, or, if in exceptional cases there were any, they would be of insignificant amounts. From 98th St. to 110th St. on Park Ave. a claim for such damages might have more apparent justification, but as Park Ave. between these streets is already a railway street, and as the presence of the rapid transit road on Third Ave. has been considered to augment rather than depreciate the value of abutting property, there would not, in my opinion, be any reasonable claim for material damages here. If, however, any claim for abuttal damages were made and sustained, it is in my opinion clear that it would be met several times over by the sum of $5,000,000, which the Rapid Transit Act added for that purpose.

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AND
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The new plan for the New York Rapid Transit railway, which is given in full in another part of this issue, differs from the old plan, which was thrown out by the Supreme Court, chiefly in comprising only those lines that are immediately necessary, and leaving the remaining portions of the system to be added as the growth of traffic makes necessary. The substitution of the Elm St. route for the Broadway line, between City Hall and Union Square, is one which this journal has always advocated. Its effect is to move the line eastward a distance of only 300 to 500 ft. over a distance of less than two miles, but it will make a saving of several millions in the cost of the road, because the road can be built in Elm St. simultaneously with the widening and reconstruction of that thoroughfare. Further than this, the abandonment of the line through the mercantile district on Broadway, will entirely avoid the opposition of the property-owners along that section, which was the main cause of the defeat of the last Rapid Transit plan. It will settle the disputed question of injuries to the buildings along the route, for it was only along this part of Broadway, where the buildings are old and the foundations are shallow that any real question on this point arose. It will also dispose of the opposition due to the proposed appropriation for the road of the sidewalk vaults along the line.

Further than this, the construction and operation of this road in such a manner as to give New Yorkers real rapid transit, will at once bring about a public opinion in its favor that will result in the early extension of three-track or four-track lines to the entire territory which the system is designed to cover.

New York has now a better opportunity than ever before to secure the transit facilities that it has so long needed. The work is in charge of a capable commission, possessing in the highest degree the public confidence, and assisted by thoroughly competent engineers. It is hampered only by the legislation under which it is working, which prescribes a plan for the construction and operation of the road that is difficult and complicated to carry into effect, and which is not calculated to secure to the city the greatest return from its investment. It is to be hoped that the new legislature, when it assembles, may remedy these faults and enable the Commission to proceed unhampered in its work. It can no longer be said that what is proposed in New York is wholly without precedent. Boston has been quietly building during the past two years a subway under its downtown business streets, not to secure rapid transit, properly speaking, but to avoid the blockade in its narrow streets due to the great numbers of electric cars. It has already rented this to the West End Ry. Co. at a price which will make the work pay for itself ultimately without cost to the city.

From a financial point of view, New York's proposed enterprise is far less risky than that which Boston has undertaken and successfully carried out, and it is to be earnestly hoped that the present plan may be carried out without delay.

The present status of the topographical survey of the City of Baltimore, as set forth elsewhere in this issue, is unfortunate, to say the least. As a preliminary to the development of annexed territory and the general improvement of the older portion of the city, an accurate and detailed survey of the existing area was ordered. This work was placed in the hands of an engineer of experience and reputation and up to the present time $160,000 has been expended upon it. The survey was generally supposed to be nearly completed upon a most exact and refined basis, but late objections made to the results as published have caused an investigation by a committee of the City Councils and the finding of this committee is now made public. The expert examination made shows that the triangulation and the precise levelling of the territory in question have been most thoroughly and accurately done, with results which are possibly even more exact than the requirements of the city ordinance would demand. But while the basis of the survey was thus elaborated it is charged that the filling in of the detail was accomplished by methods which could not, and do not give accurate results. The maps made are in error in part and do not give the detailed dimensions in feet and inches, as required by the ordinance, and fail to contain the very information for which the survey was originally ordered.

The experts appointed charge the errors found, varying from 1 to 17 ft. on some sheets, to the adoption of the metric system in the detail work and the reading of stadia rods, in most cases, only to the nearest meter. They object also to the instruments used, stating that they were unstable and not properly equipped for the critical work demanded, and they generally condemn the methods of field work as unreliable, so far as the detailed dimensions are concerned. As a result of the investigation the survey is practically suspended and is being reorganized. A general examination of the reports of the survey and the results of the investigation would seem to indicate that the engineers responsible for this work misunderstood the chief purpose in making this survey. No engineer will object to the extreme care exercised in laying down the basic lines of the survey, nor to the precise levelling done for the establishment of bench-marks for future use; even though this refinement may have cost more money than the city authorities deemed necessary for the purposes intended. But equal care should have been observed in filling in the details of the survey. After all, the valuable and essential result was the preparation of a series of maps accurately showing the detailed surface conditions, with the exact dimensions and elevations plainly expressed upon the maps in a scale sufficiently large for practical use. These maps were intended as a basis for laying out and grading new streets, for designing a comprehensive drainage system and as a record of all existing streets, blocks, structures, water distribution, sewers, etc. It is evident that for work of this character extreme accuracy of measurements was essential and errors of even a foot would be annoyingly felt. The use of the stadia for general topographical work is proper enough, and with careful methods and proper tools the results attained are usually quite as accurate as those obtained with the steel tape and much more rapid and economical. But we believe there is a limit to the refinement to which stadia work can be pushed, and that this limit was passed in Baltimore. With an ordinance calling for the determination and record of dimensions in feet and inches a telemeter reading to the nearest meter, or nearly 40 ins., could not possibly give the results demanded. In the St. Louis topographical survey the stadia was extensively used, but we are told that few buildings or street corners were thus located. With very well equipped and stable instruments, properly graduated stadia rods and the exercise of extreme care, very accurate work can be done; but the report of the experts would indicate that these conditions did not exist in the Baltimore survey and gross errors are frequent. The cost of the Baltimore survey is also excessive enough to have apparently secured more thorough work in all branches. The general cost, including triangulation and levelling, was about $9.50 per acre; while the cost for topography alone is set down at $1.50 per acre, as compared with 73 cts. for St. Louis, and 50 cts. per acre for a survey of 3,000 acres, including mapping and the location of all buildings, fences, railways, etc., in the vicinity of Madison, Ill. The more accurate survey of our older cities is to be always encouraged, and work of this character can not be too well done. But if economy in first cost is absolutely necessary, it may be said that a probable error of even more than 1 in 15,000,000 in a base line is much less likely to affect the useful and practical end of such a survey than an inefficient and inaccurate method of securing detailed dimensions. The trouble in Baltimore seems to have been that the engineers, in aiming to secure an exceptionally accurate and a most creditable base for their survey, either expended too much money upon this preliminary work, or failed to properly appreciate the practical value and necessary uses of the more detailed portions of the survey.

In our report of the test of the Roebling system of fireproof floor construction, in last week's issue, we stated that the maximum deflection of the floor before the water was put on was about 4 ins. We should also have stated that this deflection was greatly diminished after cooling. The day after the test a load of 600 lbs. per sq. ft. was placed on the roof without apparent injury, and when it was removed the deflection, or permanent set, of the roof was found to be only 1⅝ ins.

HONESTY IN THE MANAGEMENT OF CORPORATIONS.

It is a fact which is not always realized at the present day, that the corporation is an essential factor in the modern industrial and economic world. The public, as is well known, is unfriendly to corporations; and it has reasons for its prejudice in the abuses that have attended corporate management; but the fact is that there is scarcely a feature of our modern industrial system which has worked such a vast body of good to the world at large as the corporation. We use the word in its broadest sense, of course, to signify any association of persons, organized according to law, to co-operate with each other in carrying out common ends and sharing common responsibilities, but without the risk which a partnership entails. In fact, "corporation" and "co-operation," though of different etymological origin, have a similarity in significance as well as in sound. It is only by the co-operation of large numbers of men, banded together in a corporation, that the great and beneficent enterprises of this century have been possible. The railway itself, in its present form at least, would be an impossibility without the corporation.

It is seldom realized, either, what an enormous proportion of the world's business is at the present day carried on by corporations, public and private. Every city and organized village or borough is a corporation. All our railways and street railways, and nearly all our lines of water commerce are carried on by corporations. With a few unimportant exceptions we can say that all the lighting by gas or electricity, all our systems

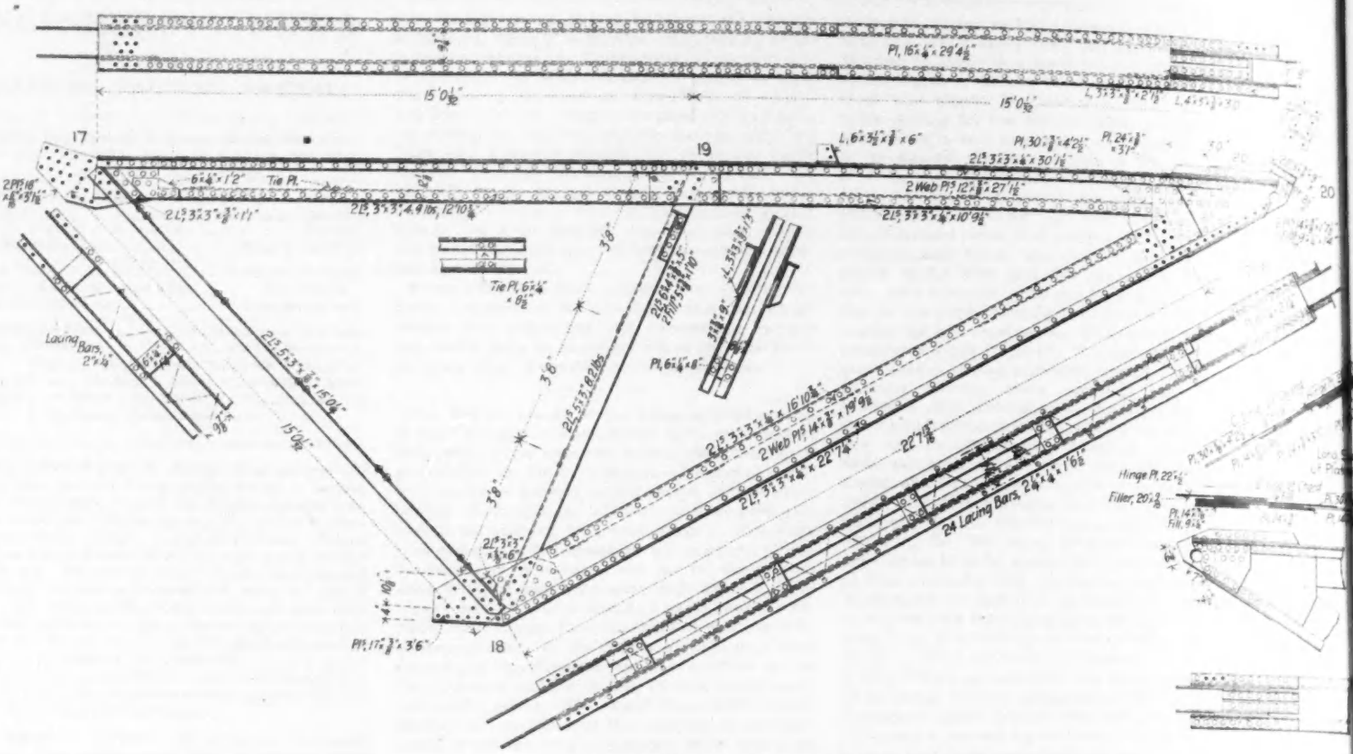


FIG. 9. DETAILS OF APEX FOR INTERIOR ARCHES A.

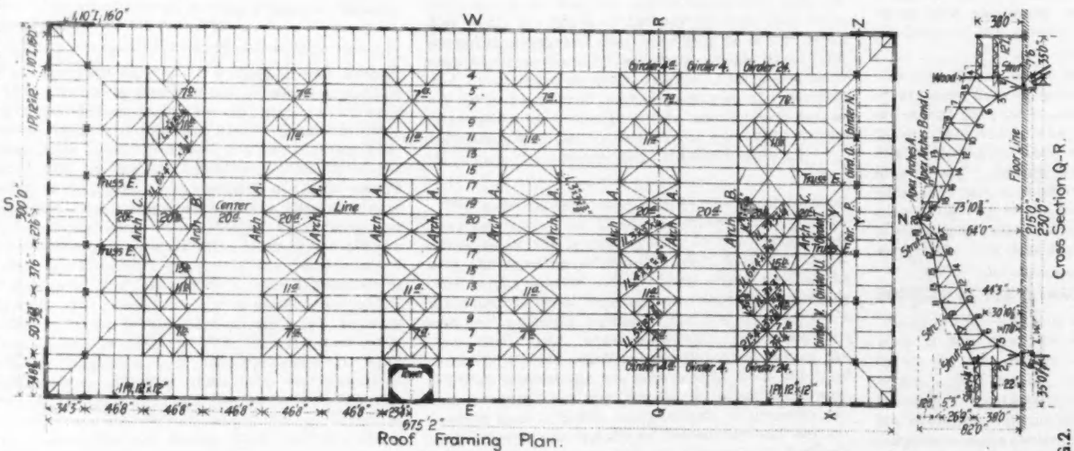
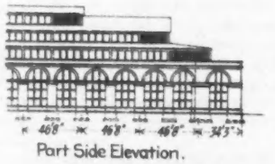


FIG. 1.

FIG. 2.



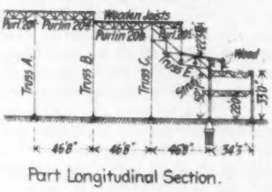


FIG. 4.

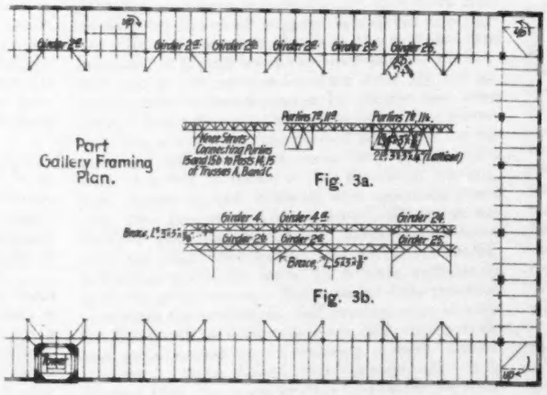


FIG. 3.

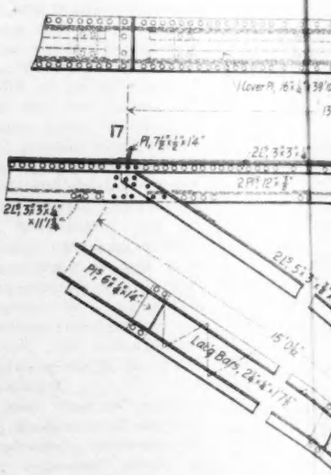


FIG. 10. DETAILS

STEEL ARCH ROOF OF THE CHICAG

Carl Binder, Chicago, Ill., Designer and Contractor for Steel

Probst Construction Co.,

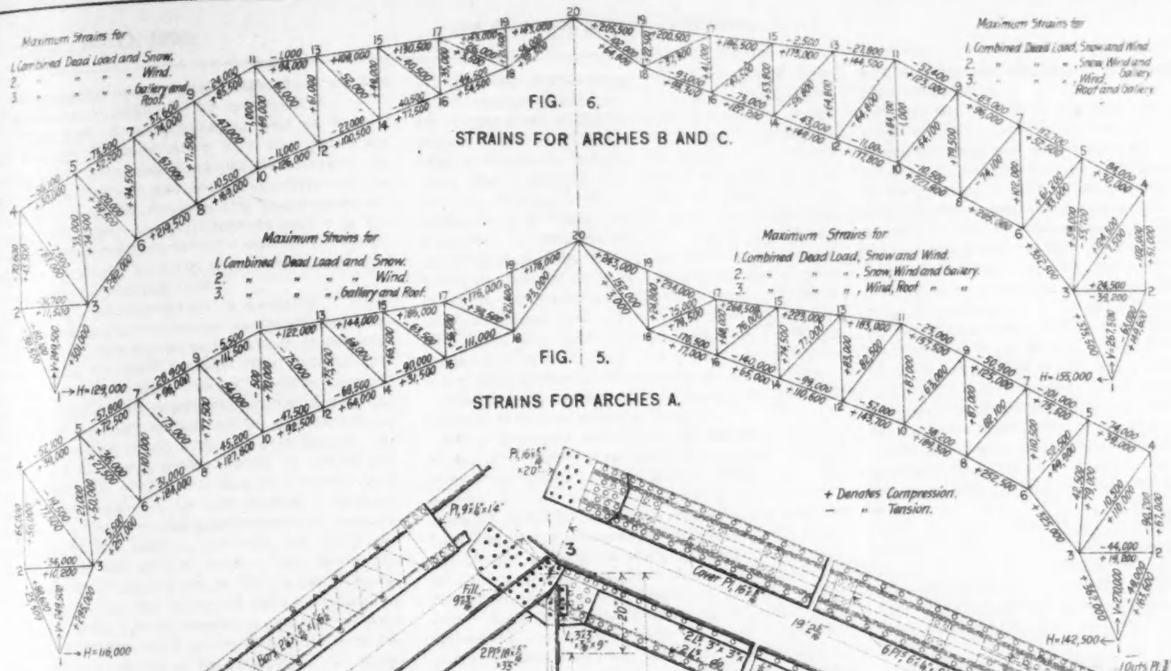

Maximum Strains for
1. Combined Dead Load and Snow.
2. " " " Wind.
3. " " " Gallery and Roof.
Maximum Strains for
1. Combined Dead Load, Snow and Wind.
2. " " " Snow, Wind and Gallery.
3. " " " Wind, Roof and Gallery.

FIG. 6.

STRAINS FOR ARCHES B AND C.

Maximum Strains for
1. Combined Dead Load and Snow.
2. " " " Wind.
3. " " " Gallery and Roof.
Maximum Strains for
1. Combined Dead Load, Snow and Wind.
2. " " " Snow, Wind and Gallery.
3. " " " Wind, Roof " "
H=129,000
H=159,000

FIG. 5.

STRAINS FOR ARCHES A.

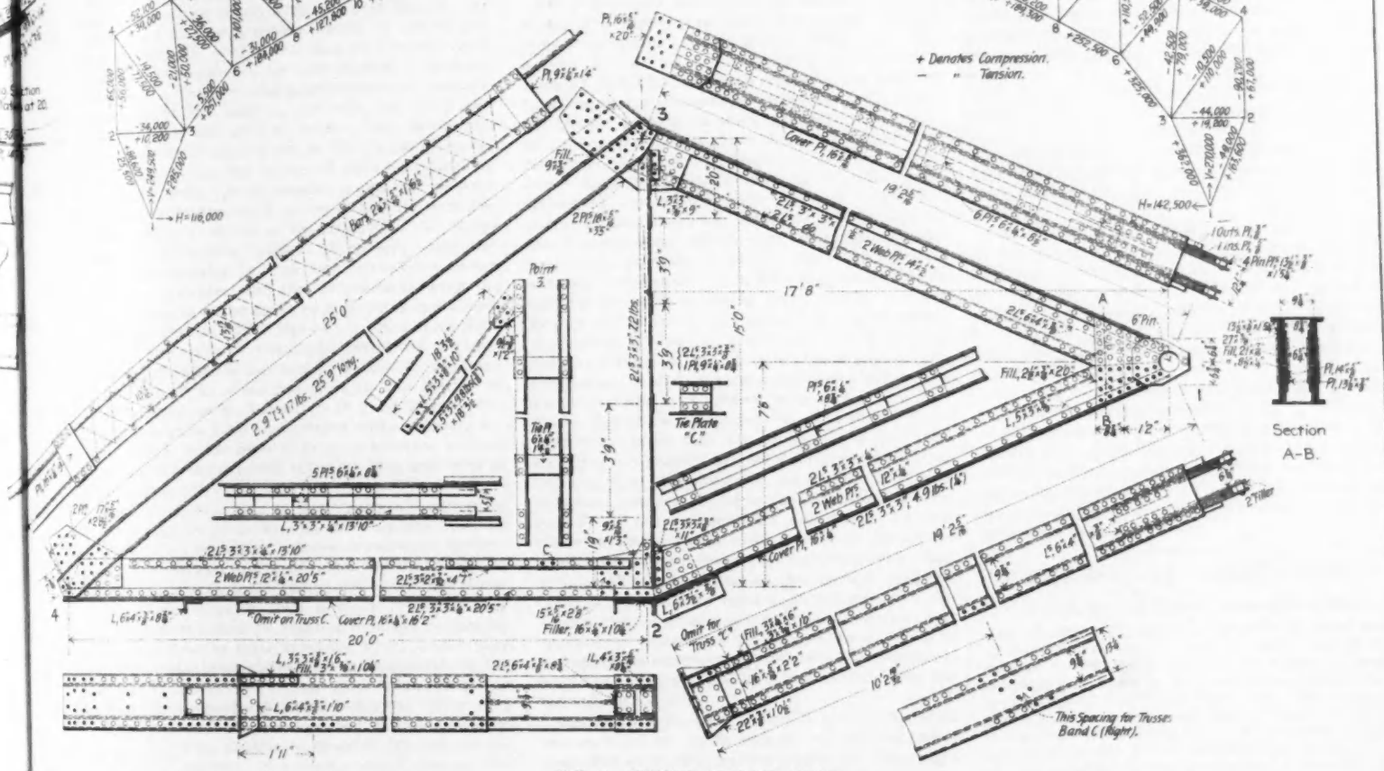
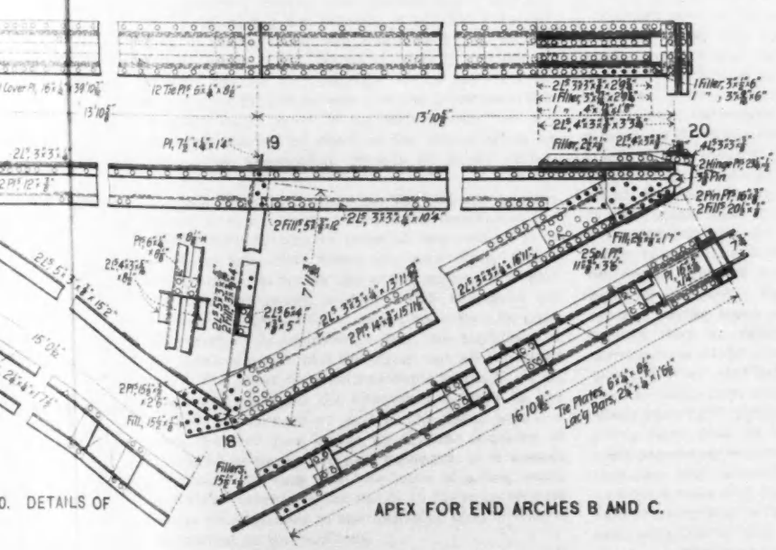


FIG. 7. DETAILS OF ARCH FOOT.



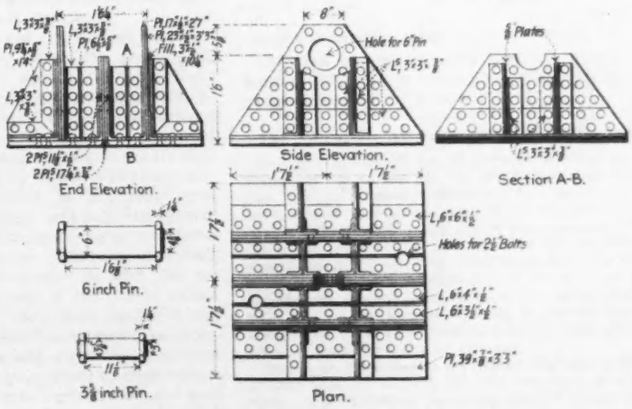


FIG. 8. DETAILS OF BEARING SHOES FOR ARCHES.

E CHICAGO COLISEUM, CHICAGO, ILL.

for Steel Work. S. S. Beman, Chicago, Ill., Architect.

ction Co., General Contractors.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

of water supply, and the great bulk of our mining operations, are carried on by corporations.

In the field of manufacturing and of buying and selling, the corporation is a less necessary factor; but here also corporations conduct the bulk of the business and are all the time tending more and more to displace the partnership arrangements which were so common earlier in the century. Corporations conduct also all our banking and insurance business, such necessary factors in the modern business world.

The great transformation in methods of business, which has accompanied the transfer of business from private hands to the hands of corporations is also not fully realized even by intelligent people. For example, nothing is more common than to hear as an argument against a city undertaking the work of lighting its own streets, or even furnishing itself with a water supply, the statement that such things should be left to private enterprise, so that the man who carries them out will be influenced by self-interest to perform the work in the best and most economical manner. The fact of the case is, however, as every one realizes who will stop to reflect, that the actual carrying out of such work, is, and must of necessity be, put into the hands of men who have no financial interest in its results, no matter whether the city does the work or some private corporation. We thus arrive at the truth that the carrying out of the great bulk of all modern enterprise must of necessity be done by corporations, either public or private; and the difference between the two classes is not so great as is sometimes claimed.

In the change which has taken place from individual enterprise to corporate enterprise, at least one great sacrifice has had to be made. We have had to part in some degree with the motive of self-interest as an incentive to good work. The man who runs his own business will ordinarily try to carry it on in the best manner possible, so that he may get the greatest returns. The man who in managing the same business on a salary has no such incentive. But in practically all industries carried on by corporations, this sacrifice must be made. The managing officers of railways, electric light plants, gas companies, etc., have as a rule no financial interest in the companies which they serve. Even when they do own some of its stock they have opportunities to make a hundred dollars by playing false to their trust for every dollar they could make through honest management in the shape of increased returns upon their stock. In fact, the temptations which beset the officer of a great railway corporation, for example, are in many respects similar to those which are set before city officials. We hear a great deal of corruption in municipal affairs; but we question whether the percentage of fraud and acceptance of "commissions" among city officials is any greater than it is among the officials of private corporations of similar size. Or, since we by no means believe in the total depravity that is frequently charged against city officials, let us say that we believe that the honest and faithful administration of positions of trust is as high among the responsible officials of cities at the present day, as among the responsible officers of great corporations.

It will be noticed that we are especially confining our comparisons between the public and the private corporations to those of large size. It is of course true that there are very many minor corporations in which the active manager is also the principal owner, and in which therefore the principle of self-interest as an incentive to good management is operative. But the tendency of the times is not in this direction; but all the other way. The great corporations doing business on an enormous scale are the ones that survive in the competitive struggles; and in the cases where a keen business man builds up a great industry of which he is the owner and manager, it is almost invariably the case that the lapse of a few years sees its ownership in the hands of his heirs and its active management in the hands of men who own no interest in the business.

Further, as respects our great corporations, we are very far from saying or believing that their active managers are, as a rule, false to their trust. On the contrary it is a remarkable evidence of the improvement in public morality and business integrity which has gone on during the present century, that it should be possible to place such a vast proportion of the world's industries in the hands of men whose moral integrity is the sole guarantee of faithful service. Every thoughtful observer of modern life cannot fail to be impressed with the fidelity with which thousands of men carry on the business entrusted to them year after year, handling affairs and funds of great magnitude with the same interest and zeal as if the business were their own, and content to receive a not always generous salary as their sole reward.

But there is another side to the picture, and in fairness that also must be drawn.

The responsible managers and heads of departments of a great corporation have always before them temptations to make gains, which if not dishonest, are at least incompatible with a high sense of moral integrity. It is very often possible to so manage a corporation's business as to cause the market price of its stock to move up or down, and the man who can cause these fluctuations can reap sure profits on the stock exchange. Again, every great corporation must of necessity have important agreements with other or subsidiary concerns, and there are mines of wealth here to the unscrupulous official. We may take for example the operation of freight cars owned by private car companies. It is well known that these cars return great profits to their owners, and are kept running while cars owned by the railways themselves are left to stand idle. It is claimed that ownership of the stock of these private car companies by officials high in authority in the railway companies is one reason why the practice continues despite efforts for reform. In another field, it is well known that the profits made by "construction companies" are not seldom recorded by a "vest-pocket" bookkeeping, which for good and sufficient reasons is never made known to the holders of the corporation's securities. Shrewd observers believe that a good part of the incentive for the great railway construction of the years 1885 to 1890, as well as of the present rage for electric railway construction, is not so much the profits that will accrue to those who own and operate the completed railway, as the fortunes to be reaped by contractors, construction companies, land companies and similar organizations from the building of the lines.

But there is no need for us to specify in detail the methods by which corporation officers can if they will grow rich on small salaries. The main point we wish to show is that these temptations exist; and that a certain percentage of men yield to them to a greater or less degree.

Turning now to the case of city corporations, we find that those who have drawn the charters of most of our cities, have apparently been wiser than the directors of private corporations, with respect to their appreciation of the temptations which beset corporation officers. The officers of almost all cities are obliged by law to let all contracts of any magnitude by public advertisement. Definite specifications must be prepared upon which bids must be received and publicly opened. We are aware that this requirement is considered a burdensome one by some engineers, especially when coupled, as it sometimes is, with the requirement that the proposal of the lowest bidder must be accepted. But the actual results of this system during many years have proved so satisfactory that we believe the directors of private corporations might well inaugurate a similar practice. It is an old and true saying, that the best way to make men honest is to keep them honest. Many men have yielded to temptation who would never have done so had not they felt that they were absolutely secure from being found out. Experience has proved that the best safeguard against frauds and dishonest transactions in business of every sort is thorough publicity. The general adoption of this principle has done wonders in the purification of the business of our cities, and it is equally applicable to the affairs of private corporations.

It will not be overlooked that the public advertisement and letting of contracts operates also as some check against loss to the corporation through the mere inertia, conservatism or lack of enterprise of its managers. In how many cases is a contract awarded by a private company without any attempt to secure competition and lower prices? The excuse given for this proceeding is a familiar one. The officer who let the contract knew the parties to be a reliable firm, who would do a good piece of work and so he gave them the contract rather than bother with several other firms which he knew nothing about. But if we suppose a case of importance where a large amount might have been saved by open competition, was it not his business to secure it and provide proper safeguards to ensure responsibility and good workmanship? Have not the stockholders of a corporation as much of a right to the benefit of the lowest possible price as have the taxpayers of a city?

We are well aware that in the case of cities the method of open competition is often objectionable from its lack of flexibility, which is one of the evils which seem to be inseparable from any business which is carried on by a governmental body. The red-tape and its delays are often irksome and costly.

But the private corporations in adopting this system are held by no such restrictions, and can have its benefits without its drawbacks. It is as effective, for example, for a board of directors to advise their executive officers to let all contracts in open competition, except when good reasons exist against so doing, as it would be to pass a mandatory resolution.

As most of our readers are aware, the practice of publicly advertising contracts of all classes is rapidly growing among private corporations. We believe that as the likeness between these organizations and municipal corporations becomes more generally realized the custom will become still more common, to the great advantage of the corporations' security holders.

LETTERS TO THE EDITOR.

A 54-in. Wooden Barrel Sewer.—Correction.

Sir: Permit me to call your attention to some errors in the description of the wooden outfall sewer in your issue of Nov. 5. These plans are not of sewers actually constructed in Brooklyn, but are adapted from plans of similar sewers of different sizes. The titles under the two illustrations were interchanged. The paragraph relating to creosoting should read: "The 'streaks' or staves are creosoted with 10 lbs. of dead oil of tar per ft. (of timber), weighing 8½ lbs. (per gallon), at 120° F." The error in the last paragraph is doubtless due to an oversight of my own. Yours very truly,

J. C. Meem.

Municipal Building, Brooklyn, N. Y., Nov. 6, 1896.

(The last paragraph states that the "sewers are built in elliptical or other shapes as well as circular, according to necessity."—Ed.)

The Cement for the Melan Bridge at Topeka, Kan.

Sir: In your issue of Oct. 29, I notice some further discussion of the cement for the Melan bridge at Topeka, Kan. In the original specification for cement for this work (which specification was fully discussed in your issue of May 7, 1896), there was a paragraph as follows: "It is not probable that any American natural Portland cement (so-called) will meet these requirements." It may be of interest to your readers to know that the later specification for the work in question, issued Sept. 2, 1896, is a revised form of the original one and does not contain the clause above recited, reflecting upon the character of American Portland cements.

This is no doubt due to the article originally published in your editorial columns and the discussion it brought forth. The thanks of American cement manufacturers are due to you for the fair treatment received in this matter. Yours truly,

American Cement Company,
R. W. Lesley, Vice-President.

22 South 15th St., Philadelphia, Nov. 4, 1896.

An Experience in Raising a Swing Bridge.

Sir: I have read your article describing "a device for raising swing bridges" with a good deal of interest, but think that Mr. Roemheld is late in mentioning it as his

invention, as I made use of practically the same scheme nearly four years ago. In January, 1893, I was requested to examine the drawbridge across the Ouachita River, near Columbia, La., on the line of the Houston, Central Arkansas & Northern Ry. I found that the pier upon which the turntable rested had settled upstream to such an extent that the bridge was 1½ ins. out of line and ⅞-in. out of level. I was then 300 miles from Little Rock without any tools other than a hammer and a monkey wrench, and only a couple of men to assist me. I found some old plates in the yard where the iron for the bridge had originally been stored and with these and some stove-pipe iron proceeded to level up the span. In front of each of the six wheels, three of which were exactly under the vertical line of each of the two lower posts, on the low side of the drum, I laid a plate ¼-in. thick, so placed that I had 3 ins. of room to make a run for the plates. The three wheels under each of the lower posts together covered one segment of the lower wheel tread. I turned the draw towards the plates, running each of the wheels, six in all, upon its respective plate, and then stopped. I next placed a ¼-in. plate behind each of the six wheels and reversed the operation, running the wheels up on the ¼-in. plates. I repeated this operation, see-sawing backwards and forwards until the drum was level. I then proceeded to level up the tread, which I did by forcing plates under each of the tread segments, excepting the two upon which the six wheels rested, spacing these supports about 12 ins. apart. In the middle of this operation it was necessary to open the draw for a steamboat to pass through, and although the tread was only supported with scrap iron we had no trouble, and at no time were trains delayed. Having the tread level all round the circle, I then tamped a rust joint under it, and took out the scrap iron plates, which of course had only been placed there temporarily. After the completion of the work every wheel in the circle took bearing in all positions of the draw. The span above referred to was a 360-ft. draw, single track. In comparing this method with that used by Mr. Roemheld, I prefer using the flat plates, as it is no trouble to run the wheels up on a plate ¼-in. thick, and when it is there, there is no fear of its running back as is likely to occur in using wedges.

Yours truly, E. T. Terry,
Terry & Tench Construction Co.
Railroad Ave. and 135th St., New York city.
Nov. 7, 1896.

Metallic Structures, Corrosion and Fouling and Their Prevention.

Sir: Will you allow me a few lines respecting your review, in your issue of Oct. 15, of "Metallic Structures, Corrosion and Fouling," as it impugns my professional status. I am not "a professional book-maker." In this country it would be impossible for an engineering one to exist, notwithstanding any liberalities of the publishers.

As far back as 1866, I was assistant resident engineer on the extensive Limehouse Dock Improvement Works, London, constructed without the intervention of a contractor. I have also had sole charge of the construction of many miles of railway and been engaged in general engineering practice, and in addition, for some 20 years, had much to do with anti-corrosive and anti-fouling paints, dozens of steamships and metallic structures having been attended to and coated through my instrumentality; the subject of corrosion and fouling has therefore been constantly before me.

In my books I record what I know and refer to the special experiments and unique experiences of others, acknowledging the source of information and so endeavor to offer as much news as possible, even though some paragraphs may appear to be contradictory. The subject is a very wide one, and to attempt to absolutely determine the relative corrosion of different kinds of iron under every condition of manufacture and use would only mislead. Flaws, which the microscope can alone reveal, have their influence, as you well know.

I am practically acquainted, as a civil engineer, with the subjects upon which I have written books, for they are connected more especially with railway and dock work. The book "Scamping Tricks," to which you refer, I wrote to record those I have seen and heard of on various works; and it was favorably reviewed in your columns. I trust writing a few books does not make one a "professional book-maker," or kind of engineering outcast.

I thank you for your review of "Metallic Structures," and for the expression, "the book contains a great quantity of useful information." I may say all the reviews in technical press here, some nine in number, have been most favorable. If attention and some light has been directed to the matter of corrosion and fouling and paints through my book (and I know of none other for engineers on the subject) I am satisfied; as, although I'm afraid you do not think so, the labor of writing such a work is very considerable and by no means professionally remunerative. Apologizing for trespassing on your valuable space,

I am, yours faithfully,
J. Newman, Assoc. M. Inst. C. E.
Logan Villas, Bath Road, Hounslow, England,
Oct. 27, 1896.

Swing or Lift Bridges for Heavy Traffic.

Sir: I have read with great interest your discussion upon movable bridges in your issue of Nov. 5, illustrated by the designs made for the Newtown Creek bridge. You say: "But when we come to narrow channels, and especially those where a large traffic is moving, the swing bridge is no longer so satisfactory." I beg to differ from your limitation "where a large traffic is moving." The swing bridge gives two passages of even greater width than can be given by any other system, through which two sets of vessels may pass at once, thus doubling the capacity of the bridge. The true place for a bascule or lifting bridge is over a narrow channel where the central pier would offer too much obstruction. Where there is room enough, it is my belief that nothing can excel the swing bridge for durability and certainty of operation.

The whole question was very carefully considered by Mr. Birdsall and myself in designing the two Harlem River bridges, and we see no reason to differ from the conclusion, then reached, that a swing bridge with two openings best accommodated the river traffic. For certainty and rapidity of action, we believe it excels any other form, and that best accommodates the land traffic.

A swing bridge can be so designed as to require the least possible power to move it. The real use of the power machines is to hold it against high winds.

T. C. Clarke, M. Am. Soc. C. E.
New York city, Nov. 7, 1896.

(The passage quoted from our editorial was somewhat ambiguous. What we should have said was, that a swing bridge is not so satisfactory for narrow channels, especially for narrow channels where the water traffic is heavy. In the case of bridges which are only opened once a day or once a week, we have no doubt that the swing bridge is the best type, even for narrow openings, where the pier has to be set to one side of the channel and a structure with unequal arms has to be built.

Our correspondent would limit the use of lift bridges to openings so narrow that a center pier would be an obstruction; but it is a matter of judgment as to when a center pier does become an obstruction. There come to our notice quite frequently accidents in the shape of collisions between swing bridges and vessels; and in a narrow and winding steam especially with a tidal or other current, it is frequently a difficult matter to tow a vessel or string of barges through the narrow opening without fouling something. Clear openings of the width of those on the Harlem River bridges, however, are probably wide enough to give all needful safety to traffic. It was openings of less width that we had chiefly in mind in our argument that the lift bridge should be considered as well as the swing bridge when the design of a structure is to be fixed.—Ed.)

The Resistance of Concrete to Fire.

Sir: In reference to the tests of various systems of fireproofing now being conducted by the Department of Buildings in this city, your short editorial in your last issue hardly does justice to the importance of the knowledge gained by them. In it you mention in reference to the Roebling test, the ability of the cinder concrete to withstand intense heat and sudden cooling. This has now been definitely proved in a second test under even more stringent conditions than the above. In the Roebling test the concrete might have been sufficiently protected by the metal lath center which upheld the arch. On Nov. 7, in a test with a fire of equal volume and temperature, the cinder concrete had no such support whatever, being laid as a beam between the I-beams; and this so withstood the effects of white heat and the shock of sudden cooling under water at sufficient pressure for sufficient length of time to ordinarily dislocate a 12-in. brick wall, that after completion of the test it was in as perfect condition as it would have been had there been no fire at all and the water only applied. This should place at rest any doubt as to the fire resisting ability of such concrete. The tests were also valuable in showing the non-conductivity of the concrete. At no time during either of these tests was the upper surface of the material too hot to handle, and although no temperature was taken of the same, I doubt whether it exceeded 150° F., about the same as that of the outside of the 12-in. walls.

But next to these two points, the most important knowledge gained was the power of the beams to both carry the load and withstand sudden cooling under such conditions. In the Roebling test the deflection of 4 ins. was largely due to loss of strength in the beam carrying the flooring, due to its heating, and the diminution of deflection after cooling demonstrated the return of strength. But the suspended ceiling which was supposed to protect the beams, gave way early in the test, exposing the lower flanges directly to the intense heat. Immediately before the application of the water when the furnace was opened these were at a white heat. I feared at the time that the application of water would cause a "firecrack" in the steel, but the latter came through the ordeal practically uninjured.

Is it not now of as much importance to ascertain the action of the steel beams under intense heat as that of the materials hitherto designed to protect them? These tests are very interesting and of the utmost importance and the lessons we are learning are changing our ideas as to design of fireproof work. The result of tests when reduced to a unit of comparison will not longer be so much as to the resistance of the "fireproof" layer as to the relative resistance of the I-beams, with various methods of protection. The moment of resistance or maximum fiber strain of the beams as shown by deflections will be the guide for determination of results.

Yours truly,
Oscar Lowinson, Jun. Am. Soc. C. E.
39 Cortlandt St., New York, Nov. 9, 1896.

(The test of Nov. 7, referred to by our correspondent, is described on another page of this issue. We fully agree with our correspondent that these tests are of the greatest value to engineers and deserve careful study by everyone interested in any way in fireproof construction. The lessons learned from these tests will greatly influence the designs and specifications for fireproof construction in the future.—Ed.)

Further Discussion of the Nicaragua Canal Survey.

Sir: Regarding the criticisms of the Nicaragua Canal route and the proposed new schemes, it must be apparent that their source is from persons whose knowledge of available data is either immature or entirely wanting. This is well stated in Mr. Le Baron's last letter in your issue of Nov. 5, referring to the report of the U. S. Commission. Its injustice, in view of the high standing of its members, in their criticism of the Canal Company's data, is only explainable by lack of complete information; although it is supposed they would have gathered some new data.

In my capacity as chief draftsman and chief of party for nearly four years in Nicaragua I can fully realize the justice of Mr. Le Baron's claims, although he is not familiar with the work of the last three years, which was very extensive. The problem of a location of the canal in the lower San Juan valley has been thoroughly investigated by many engineers eager to establish this possibility, and the experience of all fixes the impracticability of a dam of any height on the river lower than Ochoa. The only points at which such a scheme would be feasible on the Nicaraguan side are at Serapiqui, Tamborcito, and Tamborgrande. At the first there is a hill on the Costa Rican side which promises well but it is surrounded by swamps, as was proved by both Mr. Le Baron and Mr. Davis. These gentlemen ably investigated the Costa Rican side of the river at the other points with similar conclusions.

I was anxious to make the attempt to solve this problem and under the direction of Division Engineer Davis I made a careful examination of the south bank of the river from near Ochoa to Tamborcito, extending my work from two to three miles back from the river and found nothing available as a dam site except near Tamborgrande, and to my extreme disappointment the hills at that place have no connection with any spur from the Costa Rican mountains, except by connecting up various isolated hills across long stretches of very bad swamp. This district is well known to the rubber hunters, and I took every opportunity to question them both at Greytown and along the river; and all agree in saying there are no hills near the river. This is an established fact and the problem is reduced to operating a canal with low lift locks in conflict with the great floods, or the present route, avoiding these as far as possible. The latter offers the great advantages of less risk, less cost, greater facility for operating and greater permanency. These are things that must appeal to all men, irrespective of engineering training.

As to the Salinas Bay terminus for the canal, Mr. Miller certainly cannot devise any scheme for reaching it except by flying. As to the canal project in its present form: The engineer must make the best of existing conditions and there is abundant evidence to show this has been done with rare fidelity. No doubt some of the conditions are not ideal for a canal, yet the project is certainly most feasible. All the different schemes have had careful consideration and the present plan is merely the survival of the fittest, the result of most mature judgment and unquestionable ability, and in the light of many years actual contact with the data, and is not controvertible except in an equal light.

It has been my good fortune to become intimately acquainted with two of the great existing canals since leaving Nicaragua and the difficulties to be overcome there in comparison with these are apparent to me in quantity not quality. The cost estimated is most liberal in view of recent progress. Dredging, for instance, as low as four cents per yard; rock excavation at 79¾ cts. a yard now nets the contractor a large profit. The eagerness of contractors

to take the work at estimated prices is a complete vindication against any criticism of under-estimated cost. As to quantities, no data for a work of such magnitude have ever been taken so carefully and completely, and in the case of earthwork, the data would serve for a final estimate to the contractor. As to the criticism regarding incomplete data; to obtain them with the nicety that seems desirable, would require many years and an enormous outlay, could be only comparatively accurate, and finally be only useful as dependent on the judgment of the engineer. Such nicety is only useful and obtainable in the abstract, not in dealing with the concrete, as is shown in dealing with all engineering structures. The devices of the successful engineer in treating with these problems may be quite questionable, depending as they do on his judgment; yet bridges, arches, etc., were built before science was formulated. The data for designing in all the problems of the canal are known within the limits of accuracy, so that they can be used practically, and the sole idea has been to give unquestionable safety, not to figure to a least cost basis at the expense of safety. This is not permissible where the slightest accident after completion might mean irretrievable ruin to the enterprise. If the abstract values of the gagings, etc., could be placed at the disposal of the most eminent theorist his conclusions as to use in design, without actual years of experience on the ground, would not only be faulty but even dangerous to follow.

The points I wish to emphasize, in addition to those presented by Mr. Le Baron, are: that the criticisms have in view only the abstract, when the problem is with the concrete, where the judgment of the engineer is supreme; that the suppositious claims thus far made long ago had faithful and complete consideration; and hence the work of the engineers must have been of rare fidelity considering the magnitude of the many problems and the difficulties of work in a tropical wilderness where the vision is limited by the range of the machete.

Yours truly, Boyd Ehle.

Tonawanda, N. Y., Nov. 6, 1896.

Specifications for Water Tube Boilers for the St. Louis Water-Works.

Sir: The editorial on this subject in your issue of the 29th ult. is quite interesting, although not altogether complete. Being familiar with this work, and my relations being close with all the parties interested, I take the liberty of adding something to the discussion.

The work was under the immediate supervision of Water Commissioner M. L. Holman, who is a Vice-President of the American Society of Mechanical Engineers, a member of the American Society of Civil Engineers, and an ex-President of the Engineers' Club of St. Louis. In my opinion the matter has been handled in strict accord with advanced engineering practice, and is deserving of proper credit.

You express surprise that bids were received on only a few of the water tube boilers which were admissible under the specifications. This was probably due to the requirements of paragraph 2, that no boiler would be considered which did not have an established record of 65% efficiency with common Illinois coals. Unfortunately, very few makers of this type of boiler have made sufficient study of fuel economy under these conditions, to establish particularly creditable records. The St. Louis Water Department has had some rather unpleasant experiences with boilers, which although possessing excellent records with good coal had not been adapted to lower grades of fuel, and it was to avoid further experience with untried boilers that this clause was inserted.

You take the position that there should be no material difference in efficiency between any of the boilers admissible under these specifications. In my opinion this is begging the entire question, eliminating as it does the problems of size and angle of tubes, draft areas, circulation, heating and grate surface per unit of work done, ratio of heating to grate surface, draft required, water areas, path of hot gases, etc. Experience has shown us that there is quite a difference between the different types, not only of water tube, but of all other kinds of boilers. Those manufacturers who have made a study of boiler efficiency with Western low grade coals have developed designs which appear to be materially better than those which have been designed and developed for Eastern fuels. In my own experience I have in one case easily developed a horse-power on 3.56 sq. ft. of heating surface, and in another found it difficult to do the same work with 11.

In the specifications referred to, you criticise the exclusion of what in your opinion are the most important features of a boiler—the dimensions of heating and grate surface. I cannot see what difference this makes when we specify the amount of water to be evaporated, the efficiency, the dryness of steam and the required smoke performance. It seems to me that—within reasonable limits, of course—it is absolutely immaterial whether the bidder furnishes one or fifty square feet of heating or grate surface to do a given amount of work. If there were to be any preference, it would seem to be in favor of the man who did the work with the least amount of material, thus occupying less space and requiring less looking after.

Neither can I agree with your implied criticism that both Illinois coals, and Thompson calorimeters, "are apt to be very erratic." Such an opinion is not borne out by extended experience. I recently read before the Engineers' Club of this city a paper on "Boiler Efficiency, Capacity and Smokelessness, with Low Grade Fuels," which is now in the hands of the publisher and will appear shortly. Accompanying this paper are a large number of calorimeter determinations and proximate analyses of Southern Illinois coals coming regularly to this market. These figures show a striking uniformity of the coal from the same mine and of the same grade, as well as a surprising harmony between the proximate analyses, and the calorimetric determinations made with the Thompson calorimeter. For instance, the entire range of Mount Olive coal, between screened lump and slack, shows a difference of less than 5% from the average, while coal of one size varies less than 3% from the average. Coals from different mines, and of different sizes from the same mine, vary considerably, but coal from a certain mine and of the same size, shows no variation which can be termed "erratic."

Neither can I see how there can be any uncertainty in bidding on work of this kind, and I must respectfully protest against the use of the term "guess-work" in this connection. When the kind of coal is specified, the mine from which it must come, its calorific value, the method of determining its calorific value—all are clearly stated—it seems to me that every reasonable cause of uncertainty is removed. If a boiler manufacturer has had much experience with coal of this character and knows what his boiler is capable of doing, there is in my opinion much less "guess-work" as to the efficiency he is going to secure than there would be, for instance, in estimating in advance what it was going to cost him to construct and erect the eight boilers in question. In the present case, considerable time was given in advance of receiving bids, so that interested boiler-makers could conduct investigations with a view of ascertaining what their boilers would do, and I happen to know that at least two of the bidders did conduct such trials; and I know also that it was the intention of the O'Brien Co. to set up a boiler in their works and conduct a further extended series of experiments upon it, to determine the exact conditions under which it would give the maximum efficiency.

I am fully convinced that if those boiler-makers who do not approve of this way of letting boiler contracts will take the matter up and study it further, they will find that it does them no injustice, but on the contrary promises to accomplish just what it is intended to do, namely, secure the most economical type of boiler that can be built. It is, of course, unfortunate that legal complications have prevented the installation of this plant under the original specifications, and I am in a position to assure you that Mr. Holman's change of plan is not due to any lack of confidence in the method, but merely because further procedure on any line admitting competition between the two types of boilers in controversy would undoubtedly reopen the legal complications which prevented the first letting. As the city wants boilers and not lawsuits, Mr. Holman is simply taking the most direct means to accomplish his purpose.

This plan of buying boilers is not at all new. It was used by Mr. Holman himself at the Chain of Rocks boiler plant some years ago, and more recently in my own practice in the case of the boiler plant in the new City Hall here, and the Y. M. C. A. Building. Neither is it uncommon to omit all reference to either heating or grate surface, simply specifying the work to be done, thus avoiding the controversy between different manufacturers as to the amount of heating surface required to do certain work. I repeat that when a steam user buys a boiler he wants ability to evaporate a certain quantity of water per hour, and not so many feet of heating or grate surface.

I am inclined to agree with you that the O'Brien bid included a rather larger amount of heating surface than was necessary, but these people being comparatively newcomers in the water tube field, felt that they could afford to be generous in their proportions.

Respectfully yours, William H. Bryan.

St. Louis, Mo., Nov. 7, 1896.

(We are glad to have Mr. Bryan's contribution to this discussion, even though we cannot agree with him. It is by presentation of both sides of a controversy that the truth is finally brought to light. Mr. Bryan says he cannot see what difference is made by the exclusion from the specifications of the dimensions of grate and heating surface when we specify the amount of water to be evaporated, the efficiency, the required dryness of steam and the required smoke performance. No doubt he is right if the question is judged from the standpoint of the ordinary customer who is not an engineer. What he wants is so much capacity and economy guaranteed by the seller; what does he know or care about heating and grate surface? But the case is different when it is presented to a consulting engineer. Suppose a client of Mr. Bryan's receives bids for 2,400 HP. from two boiler-makers, A and B. They offer boilers of identical construction in every respect, but A offers 10.27 sq. ft. of heating surface per HP. and asks the price of $25,000, while B offers only 6.94 sq. ft. with the price of $24,000. This is exactly the St. Louis case with a change in the prices. Would Mr. Bryan advise his client to accept the $24,000 bid because it is the lowest, and would he tell him "it is absolutely immaterial whether the bidder furnishes one or 50 sq. ft. of heating or grate surface to do a given amount of work;" and that if there were any preference it is "in favor of the man who did the work with the least amount of material?" We think not. He would be more apt to say "A's boiler is over 40% larger than B's. If B's boiler is 2,400 HP. A's is more. The $25,000 boiler is by far the cheapest, but it may be larger than you need. You had better call for new bids specifying the size of boiler, so that each bidder will bid on the same thing, and not on his idea of what that thing will accomplish."—Ed.)

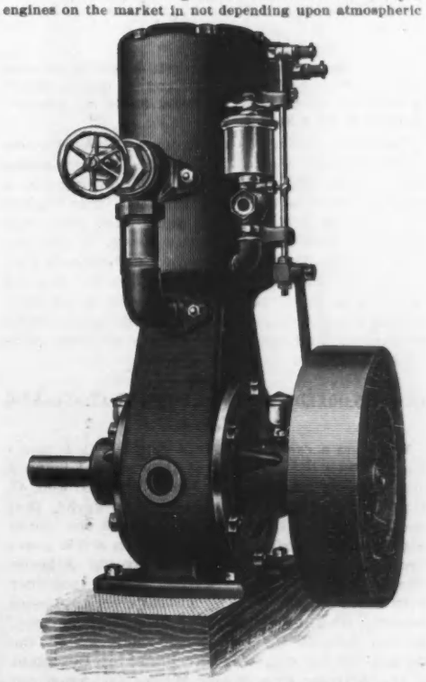
Notes and Queries.

A. W. C., Chicago, has a large body of magnetic iron ore in sand near the Chicago market, and wishes information concerning magnetic separation and briquetting the fine ore for blast furnace use.

THE SIMPLEX NAPHTHA LAUNCH ENGINE.

We illustrate in the accompanying engraving a naphtha engine recently put on the market by Chas. P. Willard & Co., of Chicago, Ill., and designed especially for launches and boats. In its general construction this engine does not differ from other vapor engines, but differs in its valve mechanism and other details, which are best explained in a brief description sent us by the designers.

The simplex naphtha engine differs from most other vapor engines on the market in not depending upon atmospheric



THE "SIMPLEX" NAPHTHA LAUNCH ENGINE.
Chas. P. Willard & Co., Chicago, Ill., Builders.

evaporation for its supply of gas. It has attached to it a generator, which is heated by the exhaust from the cylinder, thus producing a uniform gas independent of atmospheric temperature or humidity, which, as is well known, strongly affects ordinary carburetters. Owing to the method of generating the gas, lower grades and less volatile oils may be used. The Simplex engine uses successfully naphtha as low as 60° specific gravity, and produces as good results as with the highly volatile forms. In starting, no fire is used to heat the generator, it being provided with an improved vaporizing arrangement, which furnishes the engine with the vapor used in starting up. After running a few minutes, the generator is sufficiently heated to produce a generated gas to take the place of the vaporized gas.

In the Simplex engine the gases are admitted to the cylinder through an ordinary throttle valve, and by means of this the speed can be varied at will, owing to the uniform quality of the gas and the ability to successfully fire a very small charge under low compression with the aid of an improved electric igniting device which is a

combination circuit opener, closer, and sparker, and is so constructed as to permit the spark to be fired at any desirable point of the stroke. The electric circuit is held open about nine-tenths of the time when running, but this too can be adjusted as desired. The engine can be run in either direction, and in skillful hands the best method of reversing is by means of the electric switch. All that need be done is to cut out the electric switch and the engine immediately slows down, and when the piston is just reaching the point of highest compression, which can readily be seen when the engine is moving slowly, the switch is closed and the engine instantly starts in the opposite direction. This result is accomplished by the firing of the charge before the end of the stroke is reached, thus causing the crank to be propelled in the opposite direction to that in which it has been running, but in unskillful hands this method of reversing can not always be depended upon and the makers furnish a reversing device which is placed inside the boat and is operated by a lever.

Broadly speaking, the advantages claimed for this engine for boat use are: the absence of flame or fire in the boat and the necessity of carrying but a small amount of low grade naphtha. The engines are made in 2-HP., 4-HP. and 6-HP. sizes, and cost $275, $400 and $550, respectively. If high rotary speed is desired the engine can be speeded up to 500 revolutions per minute, but for general practice a speed of 300 revolutions is advised. Owing to pending patents the details of the valve mechanism and other parts cannot be made public at this time.

AN OVERLOOKED STAND-PIPE INCIDENT AT ATLANTIC CITY, N. J.

While on a recent visit to Atlantic City a member of the editorial staff of this journal learned from Mr. W. C. Hawley, Assoc. M. Am. Soc. C. E., superintendent of the city water-works, that one of the stand-pipes connected with the works had a narrow escape from destruction a few years ago. This stand-pipe was built by the Atlantic City Water-Works Co., whose works, together with those built in 1889 by a rival company, were recently bought by the city. Mr. Geo. T. Prince, M. Am. Soc. C. E., now Chief Engineer of the Omaha Water Co., was in charge of the plant of the Atlantic City Water-Works Co. when the incident occurred. In response to a request from this journal, Mr. Prince has very kindly sent us the following account of the incident:

I believe it was on Sept. 12, 1889, that the occurrence took place, at a time when there was an exceptionally high tide, probably 3 ft. above the normal high water. This resulted in overflowing the basins of the water company, located about six miles from Atlantic City on the mainland, and, in consequence, the engineer was forced to stop his pumps, but was unable to advise the writer, who at that time was in charge of the works as superintendent, as the high winds had destroyed all telegraph and telephone communication between Atlantic City and the mainland. I, however, noted the fall in our water pressure indicated by the pressure gage in the office, and surmising the truth, hastened to shut off the stand-pipe and save as much of the water as possible. This was early in the afternoon. The wind was blowing a gale from the northeast, coming in violent gusts and causing the plates of the stand-pipe to be indented; this indentation seemed to take a spiral course around the pipe upward, going off at the top with a sharp report that could be heard several blocks distant.

The pipe is 25 ft. in diameter, 132 ft. high, and anchored, I think, with eight 1½-in. rods, which pass through and are secured below the heavy cut stone masonry and grillage upon which the pipe is founded. All of the rods upon the windward side were either broken or the brackets to which they were secured, allowing the pipe on that side to lift from its foundation. I did not think it safe to allow the men to approach near enough to the stand-pipe to close the valve located on its outlet pipe and but a few feet distant, but, instead, had them shut off a number of valves in the district. This lost us time and I judge there were probably 20 or 25 ft. of water remaining in the pipe after the valves were closed.

The wind continued to increase in velocity and was recorded, as I personally observed, by the instrument at the U. S. Signal Office at over 100 miles per hour. This force, however, came in gusts and would extend for a period of say five minutes, when for several minutes there would be a lull. In the middle of the night one of my men who had made an ineffectual attempt to leave Atlantic City to carry word to the engineer to start the pumps, regardless of brackish water, visited the stand-pipe and reported to me that it was lifting from its foundation fully 6 ins. On the following day I succeeded in getting the water pumped into the stand-pipe, and thus relieved the serious condition. The gale continued until the third day.

That the pipe, after being subjected to such a trying ordeal, did not show signs of leaking when afterwards filled, convinced me that it was of excellent material and well constructed. My recollection is that the top course is ¼-in. thick and the lower, ⅜-in.; each course being 4 ft. high. It was constructed in 1882. Mr. Walter Wood, of the firm of R. D. Wood & Co., of Philadelphia, was at that time president of the Atlantic City Water-Works Co. My predecessor at Atlantic City was Mr. E. Graves, and under his direction the stand-pipe was constructed. Mr. Graves is at present Superintendent of the Camden Iron Works, of Camden, N. J.

I never saw the specifications governing the construction of this stand-pipe, but understood from Mr. Graves that they were prepared by Mr. J. D. Cook, of Toledo, O., who acted as consulting engineer in the construction of the original plant, and were similar to those which he, Mr. Cook, had prepared for the stand-pipe at Sandusky, O.

It would be interesting to know whether the metal was rolled, after the old method, from piled iron, or the modern way of rolling from the ingot. An engineer of wide reputation who has had extended experience in the use of riveted wrought-iron pipe, covering a period of more than a quarter of a century, recently expressed himself to me as strongly in favor of the former and decidedly opposed to the latter method of rolling from the ingot, and is to-day insisting upon having his plates rolled from wrought iron wired in piles before reheating. He claims that any imperfection in any separate piece of iron in the pile does not extend through the entire thickness of rolled plate, but is confined to one layer, so to speak; whereas, in the case of the rolling from the ingot, any impurities in the steel are made to cover considerable area and extend through the plate, which objection, if well taken, is pertinent to the construction of stand-pipes.

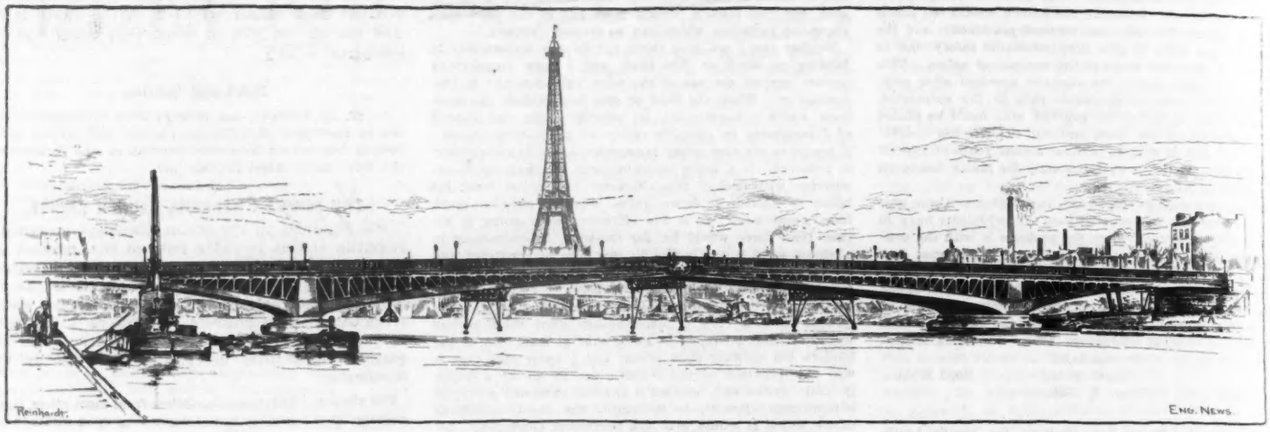


FIG. 1.—MIRABEAU CANTILEVER BRIDGE, PARIS.

Fig. 6.—Mirabeau Bridge; Pier and Truss Decorations.

Mr. E. Graves, now superintendent of the Camden Iron Works, has written us regarding the above incident, as follows:

Proof of Mr. George T. Prince's description of an incident in the history of the Atlantic City stand-pipe, together with your note of inquiry as to whether I could add anything of interest to same, is at hand. To this description there is but little more that I can say. As stated by Mr. Prince, the general specifications of this, as well as that of the first of the large stand-pipes, the one erected at Sandusky, O., in 1876, were prepared by Mr. J. D. Cook, and both erected under my personal supervision.

The plates in the Atlantic City structure are of steel, and were rolled by Park Bros., of Pittsburg. I have not before me data of the various thicknesses. Steel rivets were used, the stock for which was also made by Park Bros. The bottom of pipe is all ¼-in. thick, and is made up of a circular sheet with radial sheets joined to the first course of the shell by means of an angle. The holding-down bolts connect with lugs, which in turn are secured to the center of the first shell course at eight points in the circumference. When the tank was first completed it was found that the bottom did not lay flat on the foundation; that the pressing down of the buckles under the weight of water made leaks in the bottom calking. To obviate this difficulty a 6-in. diameter hole was cut in the center, and an ordinary half flange union secured to the plate by bolts. Into this flange was screwed a section of wrought-iron pipe some 3 or 4 ft. long, and liquid cement was poured in the top of this pipe until the bottom was raised and drawn tight by hydrostatic pressure—it assuming a spherical form with a rise in the center of perhaps 6 ins. After hardening of this cement the hole in the bottom was closed with a plug, and no further trouble was ever experienced through bottom joints leaking.

In a structure of this kind, having a semi-flexible bottom and a few feet of water in it, it can readily be seen that the weight of the water on the bottom holds back only to a small extent the first overturning motion; that as this motion increases, there is, on the windward side, a corresponding lifting of the bottom curb, carrying with it the ends of the bottom sheets. The further the ends of these sheets are lifted, the greater will be the suspended area and corresponding water load, resulting in an increasing resistance to overturning. This bottom being spherical, with an upward curve, allowed a greater swaying to top of tank than would have been the case had the curvature been downward, or had there been no slack in the bottom plates, and they had laid flat.

While this wind storm resulted in a severe test to the tank in question, that it sustained no material injury is hardly more surprising than that some tanks whose details have become familiar to the public through descriptions of their failure in Engineering News, stood long enough to be tested at all.

THE MIRABEAU CANTILEVER BRIDGE, IN PARIS.

This bridge, the first of the cantilever type erected in Paris, has recently been completed across the River Seine, but has not yet been formally opened to traffic. It connects the industrial quarter of Grenelle-Laval with the purely residential quarter of Auteuil on the right bank of the river, and the state and municipality equally shared the cost of erection, with a view of encouraging the present movement of population away from crowded centers and towards the new suburbs of modern construction.

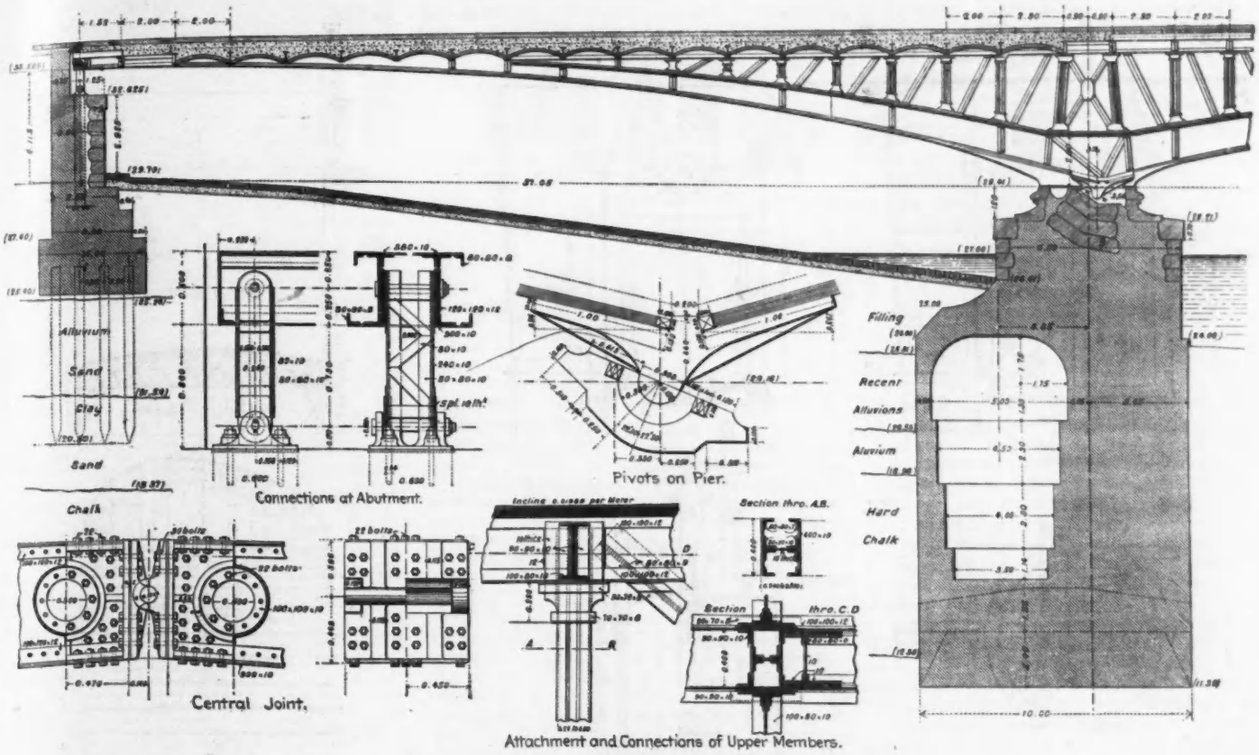


FIG. 2.—MIRABEAU BRIDGE; PIER AND HALF-CANTILEVER.

This bridge is made up of one center span of 328 ft. and two side spans of 118 ft. each, forming two cantilevers supported on pivots on two river piers and ending at two shore anchor-abutments. At the center of the river span the abutting arms are connected by a pin, or hinge. The width of the roadway is 39.36 ft., with two footways each 13.12 ft. wide. Each half of this bridge is made up of seven mild steel trussed arms, united laterally, as shown in Fig. 3, and spaced 9.84 ft. apart under the roadway, and 12.2 ft. apart under the footway. The height from the pier-pivot to the center of the bridge is 20 ft. 3 ins., and the under part of the frames takes the form of two semi-parabolas, with a horizontal axis. The depth of the frame is 17.54 ft. at the pier, decreasing to 2.75 ft. at the center and to 1.64 ft. at the shore ends. The framing of the two arms is continuous over the river piers, with the frame and arc made of box-girders. This is fixed on a steel pivot or balance, shown in Fig. 2, composed of two plates and a casting terminating in a half-cylinder, bolted to the arc of the frame. This half-cylinder rests upon a steel cushion imbedded in the granite pier. The central joint and the abutment connections are well shown in the cut, which is taken from "The Engineer," of London, along with a considerable part of this description.

The same journal thus describes the principle of equilibrium upon which the bridge was designed: Under the action of a symmetrical weight the two parts of the river span are subjected to a horizontal stress of only about 500 tons, as the weight of the shore spans compensate in great part for the weight of the river spans, and this condition makes possible the moderate depth given to the frames at the piers. Under the influence of loads this stress can be increased about four times above that produced by a permanent weight alone. The temperature also causes fluctuation in the pushing strains and brings into play the jointed anchorage. The pressure on the anchorage foundations, due to changes in temperature, varies from 71 lbs. to 206 lbs. per square inch, under the most unfavorable conditions.

The river-piers for this bridge are peculiar in construction, as shown in Fig. 2. These piers are 32.8 ft. wide and 91.8 ft. long from the river-bed downward, and rest upon a metallic caisson of the same horizontal dimensions, sunk by the use of compressed air to a hard-chalk stratum, lying about 54 ft. below the water. The sinking of these caissons, on the so-called Zschokke and Terrier system, is described as follows in "Le Genie Civil":

The top width of the pier is 22.2 ft.; but in order to increase the base area the pier was widened out by a curved offset, at about 10 ft. below the water level, and four wells were left within the base of the pier on the shore side, so as not to unnecessarily add to the quantity of masonry. The foundation material was sandy clay, soft clay and chalk, gradually increasing in hardness. The caissons are the same size as the piers, 91.8 ft. long and 32.8 ft. wide, the straight part of the sides being 68 ft. The working chamber is about 6½ ft. high and has four shafts. The two middle shafts, 2.8 ft. diameter, terminate in air locks of the Montagne system, and are used by the workmen. The two end shafts, 3.4 ft. diameter, are used for removing the material, and are fitted with the Zschokke and Terrier air locks (Fig. 4). The shafts are so placed with reference to the empty space in the pier that the masonry work can be nearly all completed before communication with the working chamber is shut off. The roof of the chamber is supported by lattice girders, as shown in Fig. 5. The working chamber is lighted by electricity. The first caisson was launched in August, 1893, and the masonry carried up to water level in two months; the working chamber was then filled with brick and rubble masonry between the girders, and all spaces filled with concrete. The second caisson was placed in November of the same year.

The Montagne air locks for the workmen are operated in the usual way. The man enters the chamber on top of the shaft and closes the outer door; he then opens a valve admitting the compressed air, and when the pressure is equal to that in the shaft he can open the door in the floor of the chamber and descend by a ladder in the shaft. The Zschokke and Terrier air locks for the removal of the excavated material are much more rapid in operation, too rapid to be used by men, as the sudden changes in pressure would be dangerous. The bucket A, Fig. 4, rests on two trunnions on racks, B, attached to a frame, C, carrying at its lower part, D, a plate which closes the bottom of the chamber, E. This frame is suspended by a chain, one end of which is fixed to the top of the

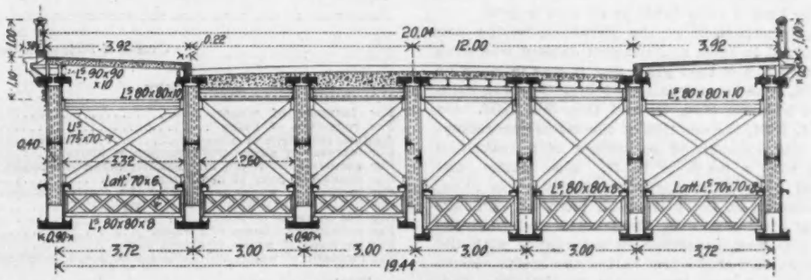


FIG. 3.—MIRABEAU BRIDGE; CROSS-SECTION.

chamber, the chain passing under a pulley attached to the bucket frame, then over a small wheel in the top of the chamber, and then running down the shaft. This wheel has a pulley on the outer end of its axle (outside the chamber), which is driven by a friction wheel of a little compressed air engine, and thus raises or lowers the bight of the chain in which the bucket is suspended. The bucket being filled is raised by the chain; when it reaches the top of the shaft, the shaft is closed by the plate on the bottom of the bucket frame, fitting against a rubber-faced steel ring, and a valve is automatically opened to release the compressed air in the chamber. As soon as this is done the swinging door in the side of the chamber is opened and the bucket dumped. This door is then closed, and the friction wheel being thrown off the bucket runs down by its own weight.

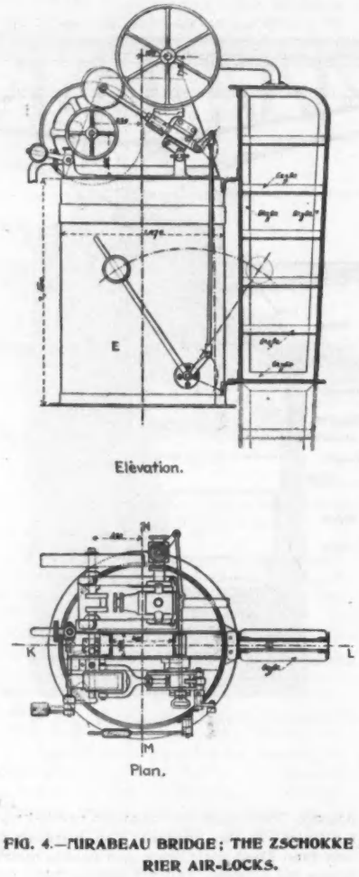


FIG. 4.—MIRABEAU BRIDGE; THE ZSCHOKKE & TERRIER AIR-LOCKS.

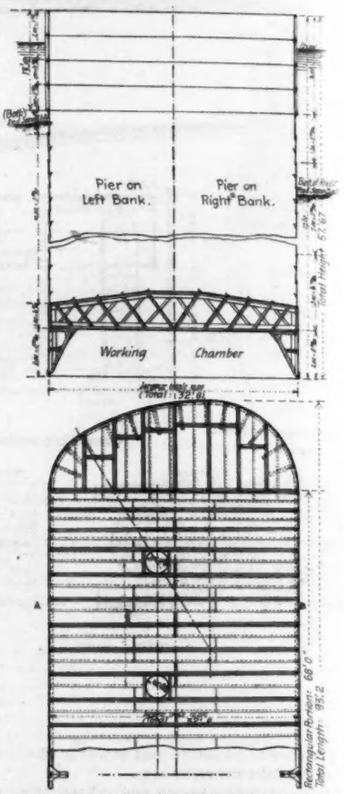


Fig. 5.—Mirabeau Bridge; Caisson.

The construction of the Mirabeau bridge was authorized in 1893, and the first caisson was sunk on August 8 of that year, and it was finished on Oct. 24. The second caisson foundation was completed between Nov. 10 and Dec. 30, 1893. On Sept. 1, 1894, the erection of the metal superstructure was commenced by means of a travelling crane with a reach of 85 ft. The bridge was erected upon false works, supported upon piles; commencing at the pier-pivot, parts of each adjoining arm were first constructed and then the river arm was completed, in accordance with the requirement that the first half of the bridge should be finished before the winter of 1894-95. This first half was finished in January, 1895, and the false works were removed and put up again under the other half by April 25, 1895. This second half was erected April 13 and August 24 in the same year. With the halves completed, the two river ends were brought into line and adjusted to the proper height and then the measurements were taken for the wedges to be placed on each arc between the center-hinge and the frames. When the wedges were prepared, the ends of the bridge were raised by jack-screws, the wedges put in and the ends allowed to fall into contact at the proper level. The roadway was then completed and on Dec. 5, 1895, the bridge was opened to pedestrians, having consumed about 18 months in construction. The superstructure weighs 2,744 metric tons, of which 2,077 tons are rolled steel, 385 tons rolled iron and 82 tons of forged steel; the remaining weight is in the ornamentation. The cost of this superstructure was about $247,000, and the total cost of the bridge was $413,400. The designer of the bridge was M. Resal and the work was carried on under M. Rabel, Chief Engineer of the "Ponts et Chaussees;" and M. Alby was the engineer in charge.

STATISTICS OF STRIKES AND LOCKOUTS.

Volume I. of the tenth annual report of the Commissioner of Labor for the year 1894, which has just been issued from the government printing office is a bulky book of 1,373 pages, of which all but the first 32 pages are devoted to tables of strikes and lockouts in the United States between Jan. 1, 1887, and June 30, 1894. The tables are arranged by states, years and industries, and the headings include occupation, locality, cause or object, ordered by labor organizations, establishments involved, closed or not closed, date of beginning and ending, duration in days, succeeded or not, wage loss, assistance to employees, and loss of employers. The introduction to the volume contains an analysis of the tables, with general summaries for the period embraced in this report and also for the period covered by the third annual report, viz., Jan. 1, 1881, to Dec. 31, 1886. From

Causes of Strikes in the United States for 13½ Years.

Items.	Jan. 1, 1881, to Dec. 31, 1886. Establshmts.	%	Jan. 1, '87, to June 30, 1894. Establshmts.	%
For increase of wages	9,439	42.32	12,041	25.69
For reduction of hours	4,344	19.48	6,199	13.23
Against reduction of wages	1,734	7.77	3,830	8.17
For increase of wages and reduction of hours	1,692	7.59	3,095	6.60
For reduction of hours and against being compelled to board with employer	800	3.59	.....	.....
For change of hour of beginning work	360	1.61	.....	.....
For increase of wages and against the contract system	238	1.07	.....	.....
For 9 hours' work with 10 hours' pay	172	.77	.....	.....
Against increase of hours	138	.62	.....	.....
For reduction of hours and wages	126	.56	.....	.....
For payment of wages overdue	...	...	383	.82
For increase of wages and reduction of hours on Saturday	...	...	378	.81
Total	19,043	85.38	25,928	55.32
For increase of wages and against employment of non-union men	215	.96	.....	.....
Against employment of non-union men	162	.73	1,688	3.60
In sympathy with strike elsewhere	173	.77	3,620	7.73
For adoption of new scale	...	...	1,559	3.33
For adoption of union, etc., scale of prices	142	.64	.....	.....
For adoption of union rules and union scale	...	...	783	1.67
For recognition of union	...	...	1,314	2.80
For adoption of union scale	...	...	844	1.80
For increase of wages and enforcement of union rules	132	.59	.....	.....
For increase of wages and recognition of union	145	.65	686	1.46
To compel World's Fair directors to employ only union men in bldg trades	...	...	472	1.01
For reinstatement of discharged employees, etc.	124	.56	467	1.00
Total	1,093	4.90	11,413	24.40
All other causes (297) 1881 to 1886	2,168	9.72	.....	.....
All other causes (376) 1887 to 1894	...	...	9,521	20.28
Grand total	22,304	100.00	46,862	100.00

these summaries we have abstracted the following figures:

Strikes and Lockouts in the United States From Jan. 1, 1887, to June 30, 1894; 6½ Years.

	Strikes.	Lockouts.
Total strikes and lockouts	5,909	244
Establishments	28,662	2,970
Employees thrown out employment	955,252	140,135
Wage loss of employees	$34,988,100	$12,108,463
Loss to employers	28,786,446	5,754,286
Assistance to employees[1]	4,590,177	671,818
From Jan. 1, 1881, to June 30, 1894; 13½ Years.		
Establishments	69,106	6,007
Average duration, days	25.4	47.0
Wage loss to employees	$163,807,657	$26,685,516
Assistance to employees[1]	10,914,406	2,524,298
Loss to employers	82,598,786	12,235,451
Establishments in which strikes or lockouts succeeded, %	44.49	40.33
Failed, %	44.23	47.75
Succeeded partly, %	11.25	9.58
		Per cent.
Number thrown out of employment in successful strikes	1,188,525	32.00
In strikes which failed	2,061,259	55.50
In partly successful strikes	462,777	12.46
In total strikes	3,714,231	.....

[1]By labor organizations.

The report contains two tables summarizing the leading causes of strikes for the two periods, Jan. 1, 1881, to Dec. 31, 1886, and Jan. 1, 1887, to Dec. 31, 1894. We have rearranged these two tables to make the one given below so as to place in contrast the figures for the two periods, and bring out a matter which does not seem to be discussed in the report, viz.: the apparent tendency to a change of the principal causes of strikes from those relating to differences of opinion between employers and employees concerning wages and hours of labor, to those relating to recognition of unions, employment of non-union men, "sympathetic strikes," etc. Of the several causes specified in the tables it appears that those relating simply to wages, hours, etc., comprised 85.38% of the total number of strikes (counted by establishments) in the first period, and only 55.32% in the second, while the specified causes of the second class, those relating to unions, sympathetic strikes, and the like, were only 4.90% in the first period and 24.40% in the second. The increased domination, or attempted domination of the unions, in recent years, of which these figures seem to give evidence is a subject well worthy of study by those interested in labor questions.

TESTS OF THE THOMSON AND THE McCABE FIRE-PROOF FLOORS.

Two additional tests in the series of fire and water tests of fireproof floor constructions, which is being conducted by the Building Department of New York city, were made during the past week at the testing grounds, 68th St. and Avenue A. Mr. Frank Rutherford was the expert of the Department in charge. The first test, made on Nov. 7, was of the floor designed by G. H. Thomson & Co., No. 51 East 44th St., New York. The test was made in a brick building similar to those used in the tests of the other floors which have been described in our columns in the past few weeks. The interior size of the building is 11 × 14 ft. and the walls are 1 ft. thick. The floor tested, which formed the roof of the building, was constructed of 6 in. light I-beams, 12 ft. long, spaced as in the accompanying sketch, the space between the beams being entirely filled, as shown by a concrete made of 1 part of Dyckerhoff Portland cement, 2½ parts clean sand and 6 parts ashes, and treated by a chemical preparation the nature of which has not been made public. The underside of the flanges of the beams was protected by two layers of hardened clay preparations of different constitution, the first ⅛-in. and the second ¾-in. thick; and further by ½-in. of cement mortar, held in place by wire netting. The underside of the floor or ceiling was then plastered with a coat of about ½-in. of ordinary lime plaster. The most important difference between the construction of the Thomson floor and that of the other concrete filled floors before tested is in the disposition of the beams, which are only 6-in. I-beams, weighing 13 lbs. per ft., 12 ft. long between centers of supports and 3 ft. 6 ins. apart c. to c. In the other tests the beams were 10-in., 25 lbs. per ft., 15 ft. long between supports and spaced 4 ft. apart. The beams in the Thomson test were therefore subjected to a much greater fiber strain for a given load per sq. ft. of floor than those in the other tests. Before the test the central panel of the floor was loaded with 6,300 lbs. of pig iron, or 150 lbs. per sq. ft.

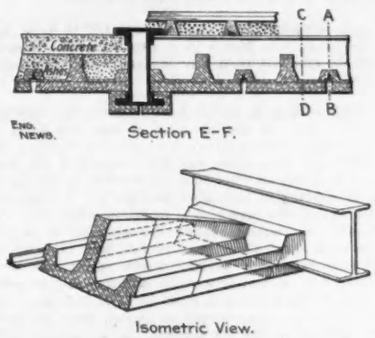
CONCRETE FIRE-PROOF FLOOR CONSTRUCTION.
Designed by G. H. Thomson, M. Am. Soc. C. E., New York City.

The test was begun at 10 a. m. by lighting the fire of cordwood. The temperatures were taken by a Uehling & Steinbart recording pyrometer. By 10.45 a temperature of 1,775° F. was recorded, and at 10.57 2,200° F. The highest temperature was 2,250° F. at 1.45 p. m., and from 11 a. m. to 3 p. m. the temperature remained above 2,000°, except when the doors were opened for charging firewood. A double grate was used as in the earlier tests, so that the air supplying the upper grate might be heated by passing through the lower fire. At 3 p. m., after five hours of continuous firing, a strong stream of water supplied by a fire engine was directed against the underside of the ceiling, and when the interior of the building was sufficiently free from steam to be observed, it was found that the concrete filling between the beams was practically uninjured, the plaster coating, where the full force of the water struck it having been torn off. The maximum deflection of the floor observed during the test was only 1.82 in. at 2.57 p. m. After cooling this had reduced to 0.7 in. On Nov. 10 a load of 600 lbs. per sq. ft. was placed on the floor, and it developed only 0.37 in. deflection.

The next test was made on Monday, Nov. 9. It was made at the same place, and in a building of the same style as those used in the previous tests. The floor tested was designed and patented by Mr. Peter McCabe, of McCabe Bros., 33 West 64th St., New York city.

The floor is constructed as follows: The I-beams, 10-in. medium weight, 15 ft. long, running lengthwise of the building, are spaced 4 ft. apart c. to c. Upon their lower flanges is built a series of flat arches, made out of ribbed blocks of the shapes shown in the accompanying cuts. These are made of a composition of plaster of paris and ashes. After the arches of plaster blocks are laid the spaces between their upward projecting ribs are filled with dry ashes, the upper surface being rounded off to the arched form of the top of the rib. The whole space between this rounded surface and the level of the top of the upper flange of the 10-in. I-beam is then filled with a cement concrete, made of 1 part Portland cement, 2 parts sand and 4 parts ashes. The lower sides of the plaster blocks extend about 2½ ins. below the flanges of the I-beams, as shown. Light T-irons, inverted, are laid on the lower flanges of the I-beams for the purpose of supporting the arch blocks while they are being laid, and possibly of contributing to the strength of the floor.

The middle panel of the floor having been loaded with pig iron to the amount of 150 lbs. per sq. ft., the test was begun at 10 a. m., and continued five hours. By 11 a. m. the temperature had reached 1,500° F., by 11:20 it was 2,000°, and by 11:30, 2,250°. The highest temperature attained was 2,325°. Between 11:20 a. m. and 3 p. m., the temperature was kept above 2,000°, except for short intervals, while fresh wood was being charged. The maximum deflection during the test was only 0.33-in., which is much less than that found in any of the floors previously tested. Its small amount is no doubt due to the greater thickness of the construction, as compared with that of the other floors, and to the very complete protection of the lower side of the beam. On cooling very little change in the deflection was found. At 3 p. m., the floor was cooled by a stream from a fire engine, about 15 minutes being required. When the steam had cleared away it was found that small portions of the plaster blocks had fallen out in three places exposing the concrete arch above, and that a portion of the plaster blocks under the flange of the I-beams had also fallen off. It is probable that most if not all of this damage was done by the force of the fire stream. The concrete arch where it was exposed appeared to be entirely uninjured.



CONCRETE AND PLASTER OF PARIS FIRE-PROOF CONSTRUCTION.
Patented by Peter McCabe, New York City.

TWO JAPANESE CRUISERS are to be built in the United States, one by the Cramp Ship & Engine Company, of Philadelphia, and the other by the Union Iron Works, of San Francisco. While the contracts have not yet been formally signed, the proposals of the American firms have been accepted. The new cruisers are to cost about $1,250,000 each, and the proposals call for a speed of 21 knots and 17,000 I. HP. Each cruiser will have about 5,700 tons displacement, with a length of 335 ft. on the water line, 51 ft. extreme beam, and 20 ft. mean draft. The main battery is to include four 8-in. and eight 5-in. rapid-fire guns, with a secondary battery of twelve 6 pdrs., six 1 pdr. and four Gatling guns. The Japanese government is said to be about closing contracts with the English shipbuilder, Armstrong, for two first-class battle ships and one armored cruiser; besides these, it is contracting for five 150-ton 24-knot torpedo boats and several torpedo boat destroyers, in England, five torpedo boats of the same class in France and five more from German firms.

THE TIDAL SURVEY of the Gulf of St. Lawrence has been in progress for three years. The first season was occupied in examining the Belle Isle and Cabot Strait entrances and in fixing the general relation between the tides and currents of the gulf and the ocean. The second season was devoted to the St. Lawrence entrance between the Gaspe coast and Anticosti and the nature of the currents were traced across the southwestern side of the Gulf to Cape Breton. During the present year the northeastern arm of the Gulf, from Anticosti to Belle Isle, has been under examination. This arm of the Gulf has an area equal to that of the English Channel and through it passes all the Atlantic trade taking the Belle Isle route. Tide tables are now published covering the approach from Halifax to Quebec, the first tables which are based upon direct observations.

WHEELER-STERLING ARMOR-PIERCING PROJECTiles were tested at Indian Head, on Oct. 30, against a 12-in. Carnegie nickel-steel plate. The shell was 12 ins. in diameter, and represented a lot of 75. It was fired with a velocity of 1,800 ft. per second and though it pierced the plate it was badly shattered. The lot was rejected under the present regulation requiring the shell to not only penetrate the plate, but to pass through the trial without splitting or breaking up. The late trial is said to have brought about a change in this regulation, calling only for penetration without regard to the final condition of the shell.

THE SUBMARINE TORPEDO BOAT, invented by Mr. John P. Holland, which is now being built at the Crescent Shipyards, Elizabethport, N. J., is expected to be launched about Jan. 15. It is a cigar-shaped vessel, 50 ft. long and 10 ft. diameter, constructed of double steel plating 7-16-in. thick forward, tapering to 5-16-in. aft. The motive power will be electricity and compressed gas, either of which may be used separately, or they may be coupled when the highest speed is desired. The only superstructure will be a telescopic conning tower, 3 ft. diameter and 1 ft. high. The displacement of the vessel will be 66 tons. Her armament will consist of a gun for throwing aerial torpedoes containing 200-lb. charges of high explosives, and her magazine will contain, in addition, six or seven "Whitehead" torpedoes. Her speed below the surface will be nine knots for twelve hours, or twelve knots for four hours, while being operated by electric current, and when awash she will develop eight knots under gas pressure. When launched, she will be fitted with a 50-HP. gas engine, but at a later date a 300-HP. motor will be used, which is expected to generate a speed of 16 knots. The cost of construction will be about $75,000. The larger boat of the same class, which is being built under contract with the U. S. Navy Department at the Columbian Iron Works, in Baltimore, and which was described in our issue of March 12, 1896, is expected to be completed in February.

THE MISSISSIPPI JETTIES are in danger, says the New Orleans "Times-Democrat," from the existence of a crevasse, 3,000 ft. wide, leading from Pass a l'Outre to Garden Island Bay and to the Gulf. The South Pass, the one opened by the jetties, lies between the Pass a l'Outre and the South West Pass, and Mr. Eads laid mattresses across the mouths of both of the other passes to divert the water towards the center pass and to keep up the scour in that channel. But the mattress across the end of the Pass a l'Outre has been broken by floods and a deep channel formed at the mouth which leads a large volume of water into the northern arm of the delta. A crevasse has also been formed in the south bank, about 1½ miles below the head of the pass, and by making a shorter route for the water and decreasing the fall, it is estimated that about 52% of the volume of the river water now empties into the Gulf by this north channel and 25% goes through the crevasse. This output decreases the flow in the South Pass and it is said to be growing shoaler and narrower at an alarming rate. The crevasse occurred in 1891 and there is now a gap 1,200 ft. wide and 84 ft. deep between the end of the Pass a l'Outre mattress and the South Pass works. The executors of Mr. Eads, at their own expense, attempted twice to close this gap, but without success. Major B. M. Harrod, of the Mississippi River Commission, says that the crevasse at Pass a l'Outre, should be closed at once. But it must be done by the government, under a special Congressional appropriation, as there is nothing in the Eads contract compelling them to perform this work. Major Harrod favors the immediate improvement of the South West Pass, which is now deeper than the South Pass, when work was commenced upon it, for it has 12 to 14 ft. over the bar, as compared with 8 or 9 ft. in the original South Pass. The necessity for speedy action by the government is made more apparent by the fact that the Eads contract expires in July 1899, and something must be done, either to preserve the channel at the South Pass, or to secure a wider and deeper entrance at the South West Pass.

THE UNITED STATES EXPORT ASSOCIATION, incorporated "to encourage the consumption of American products in other countries," has issued its fourth bulletin, designed for circulation in the English colonies. It sets forth the advantages possessed by American manufacturers in special lines and gives a long directory of American business houses. Mr. F. B. Thurber, the President of the Association, together with his assistants, are actively at work, and they already have the co-operation, as members, of a large number of leading houses in many lines of business. An information bureau has been organized by the Association which will answer free of charge any queries put to it, both from buyers and sellers of goods. The purpose of the Association is a most laudable one; and properly aided by those most interested, American producers, it should accomplish in this country what a similar persistent effort and organization has done for European producers. The offices of the Association are at 143 Chambers St., New York city, and application to that address will obtain fuller details as to the purposes and progress of the work.

THE BRUSSELS INTERNATIONAL EXPOSITION is to be held between May 24 and Oct. 31, 1897, under the auspices of the King of Belgium and the municipality of Brussels. The exhibits will include those usually seen at expositions of this character, and the Commissioners of the United States, Messrs. J. H. Gore and Thomas Wilson, call the special attention of American manufacturers to this opportunity for extending their trade by proper exhibits. Application for space must be made before Jan. 1, 1897, and the general rules for admission, classification, etc., may be obtained by addressing the Commissioners at Columbian University, Washington, D. C. An effort is also being made to obtain special freight rates for exhibits from the Red Star Line to Antwerp, and full particulars can be obtained by addressing this company at 6 Bowling Green, New York city.

AN INTERNATIONAL EXHIBITION is to be held in Guatemala from March 15 to July 15, 1897. Information can be obtained from Mr. Joaquin Yeto, Consul-General of Guatemala, New York city.

THE DECIMAL GAGE for measuring the thickness of sheet metal and the diameters of rods and wires which was adopted last year by the American Railway Master Mechanics' Association was also adopted by the Association of American Steel Manufacturers at its regular quarterly meeting in New York on Oct. 23. A committee of the Association presented a report in which they gave a number of reasons against the adoption of the U. S. Standard Sheet Metal Gage of 1893 and in favor of the decimal system of gaging, which report was formally indorsed by a resolution of the Association. An extended abstract of the report is given in "The Iron Age" of Oct. 29. In the decimal system of gaging, gage numbers are not used, as in the old systems, but the actual thickness in thousandths of an inch is used instead. For convenient shop measurements a notched gage is used, of sheet metal, 0.1 in. thick, and of elliptical shape, $4 \times 2\frac{1}{2}$ ins. Such a gage with 38 notches is furnished by the Pratt & Whitney Co., of Hartford, Conn., for $5. The gage has been adopted in the shops of all the principal railways of the United States and Canada.

THE URBAN POPULATION OF THE UNITED STATES is discussed in "Scribner's" for October. It is stated that more than one-third of this total population now live in cities. In some states this percentage is much exceeded, as it is 70% in Massachusetts, 60% in New York, 54% in Connecticut, and 52% in New Jersey. In 1790 there were only six cities of more than 8,000 inhabitants; in 1890 there were 448 such cities. In 1840 there were only three cities with more than 100,000 inhabitants; in 1890 there were 28 cities of this population. In 1896 the 3,200,000 inhabitants estimated for the Greater New York almost equal the population of the 13 United States in 1789.

THE CHEMICAL PROFESSION appears to be badly overcrowded in England, if we may trust an editorial in "The Engineer." We quote from it as follows:

> There are fifty chemists clamoring for every insignificant appointment in this country; and large numbers of German chemists are working here for salaries which would scarcely pay the tailor's bill of an Englishman. In few words, it does not pay in this country to make your son a chemist. If he has nothing but the income derived from the practice of his profession to rely upon, he will have to live a life of genteel poverty, cursing the hard fate which made him and his parents select a profession which pays no one properly at the beginning and leads to nothing at the end. No doubt a few chemists have made fortunes. In like manner a few large nuggets have been picked up in Australia, and a few large diamonds in South Africa. For the great mass of chemists in this country an income of about £150 a year represents the ultimate life return for a large outlay of time and money.

PROJECTS FOR THE UTILIZATION OF COMpressed air in street cars and motor carriages are being "boomed" at a lively rate, but details of the apparatus used are carefully withheld from the public. Experiments are said to have been carried on for several months at the works of the American Wheelock Engine Co., in South Worcester, Mass., on a motor adapted for heavy wagons, cabs and private vehicles. At the same works experiments are being made on street car air motors for the Metropolitan Traction Co., of New York. A trial trip of a carriage motor was recently made in Worcester, at which a speed of 25 miles an hour is said to have been made. It is stated that if the experiments are successful, a stock company will be formed for the purpose of operating a system of air motor cabs in some of the large cities.

THE MAKING OF GAS FROM ANTHRACITE COAL dust is being exploited in Scranton, Pa., by the "Anthracite Gas Producer Co.' Mr. J. Gardner Sanderson, the inventor of the gas producer read a paper before the Scranton Board of Trade on Oct. 19, describing the process in which he made the following statements:

> Now as to what we are able to do, with the millions of tons of waste coal scattered through the coal regions. After working over the piles and extracting all the marketable sizes, the earth will still be encumbered with millions of tons of unmarketable stuff. With this I am prepared to make a gas as valuable for fuel as the best prepared coal, and far more efficient in power-using gas engines than the best of coal with steam engines. Special devices were necessary in the use of culm. It could not be made in any of the producers before made. * * * These provisions being worked out, we are able to produce gas with this material without more trouble or cost than with prepared coal, and this we have been doing for several months. By actual measurement we produce and store from 88,000 to 120,000 cu. ft. of gas with [illegible] ton of fine waste from the washing. With culm from the pile, after taking out all the sizes from buckwheat, we get about 140,000 cu. ft. per ton. Fifty cu. ft. of gas in a gas engine is a large allowance for one HP. per hour, hence one ton of culm will furnish 2,800 HP. per hour, or 280 HP. for ten hours, and there is no waste of fuel when the power is not in use. No boilers to care for, insure or explode, and but little expensive water required.

The figure 230 is probably a misprint for 280. It would be interesting to know what kind of gas it is that can be obtained from anthracite culm in such large volume as 140,000 cu. ft. per ton, and the statement that 50 cu. ft. of gas per HP. per hour is a large allowance, might also be made more definite if the quality of the gas were stated. The number of pounds of coal to the ton is not stated, but if we assume 2,240 we obtain the following: 2,240 lbs. culm furnishes 2,800 HP. for one hour, which is equivalent to $2{,}240 \div 2{,}800 = 0.8$ lb. of culm per HP. per hour. This beats even what is claimed for the Otto Thermic engine, described in our issue of Oct. 22, and we beg to be excused from believing it without further proof than the statements of the inventor.

THE BRIDGE OF ALEXANDER II., which will be built across the Seine, in Paris, as a part of the Exposition of 1900, is thus briefly described in "Le Genie Civil": It will have a single arched span of 110 m., or 360.8 ft., with a rise of 21.32 ft. and a width of 131.20 ft. The arch will be built of mild steel, and will be hinged at the center and at the two abutments. The Emperor and Empress of Russia laid the corner-stone during their recent visit to Paris.

INSUFFICIENT FORCE OF INSPECTORS of the Building Department is becoming a common complaint in our large cities, especially since the erection of tall buildings of structural steel has become common. Mr. John B. Brady, Building Inspector of Washington, D. C., in his recent annual report requests that the number of his field inspectors be increased from two to seven. The constantly increasing amount of work of a miscellaneous chararacter that the department must look after makes the additional force necessary.

DRIFTING SANDS are gradually encroaching upon Provincetown, on the extreme northerly point of Cape Cod, and the Massachusetts Harbor and Land Commissioners are now attempting to reclaim this area by grass planting. The State owns 3,000 acres of this land which is divided into two well-defined strips; one belt heavily wooded, and the other and larger one made up of shifting sand dunes lying next to the sea. This sand belt is continually moving southward and upon the timbered land. By planting beach grass and other hardy fibrous plants about 45 acres have been reclaimed since 1894 on an annual appropriation of about $3,500.

A NEW TROUGH FLOOR CONSTRUCTION which is claimed to offer several advantages over the styles at present in use has recently been patented by Mr. M. F. X. Foley, 257 So. 4th St., Philadelphia. It is made up of standard steel shapes and requires only four rows of rivets per trough, all of which can be machine driven, as compared with eight rows of rivets in the troughs built up of plates and angles. The troughs can be made of any desired depth, and the cost of manufacture, it is claimed, can be made so moderate as to considerably increase the use of this type of floor.

THE LOAD ALLOWED ON FLOORS of buildings used for the sale, storage and manufacture of merchandise, and of public livery, sale and boarding stables, according to the rules of the New York Building Department, is required to be stated on a placard publicly displayed on each floor. Efforts are being made by the Department to compel a rigid enforcement of this rule.

THE CONSUMPTION OF COAL BY THE WARSHIPS of the United States Navy in the last fiscal year, according to the report of Commodore Chadwick, Chief of Naval Equipment, was 116,903 tons, costing $620,131. Of this amount 61,741 tons were purchased abroad. Only 45% of the total was used for steaming purposes, the remainder being used for auxiliaries, including electric lighting, ventilation, etc. A cargo of Pocahontas coal has been placed at Honolulu for the re-coaling of vessels at that point at a rate which allows it to compete successfully with coal from Canada or from Australia.

A PLANT FOR THE MANUFACTURE OF FUEL GAS by the Burdett-Loomis process has been erected at Bridgeport, Conn., by the Citizens' Gas Co. It is said to be the largest city plant for making fuel gas in the world. At present it supplies fuel for 300 homes and for several factories, including those of the Yost Typewriting Co. and the Monumental Bronze Co. The price charged is 50 cts. per 1,000 cu. ft., with liberal discounts, according to the amount used, ranging from 20% for small bills to 50% for bills for 50,000 cu. ft. and upward per month.